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Index to Advertisers and Classified Index Following Reading Matter.

Besly Grinder Will Reduce Your Toolmaking Expense

If you knew what a saving this machine would make in your manufacturing toolroom, you wouldn't be without it for many times its price.

Here is what two of the best known mechanics in the world say about the Besly Grinder.

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PROVIDENCE, RHODE ISLAND, November 9, 1909.
The Besly Grinder is a very useful tool and is the best of its kind that we know of, and, we think, largely owing to the spiral grooved wheel that is used on it. They are easy to cover, hold their edge well, and cut clean. We have several of the machines in use about our factory and they are used to good advantage.
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No. 1 R Besly Grinder.

Helmet Spiral Disc Wheel with circle torn to show construction. Glue imbeds in spiral grooves in steel disc wheel and acts as a driver to the circle, same as the tail of a lathe dog.

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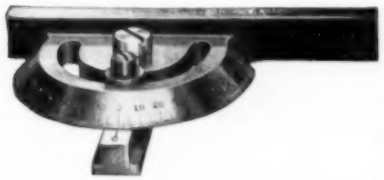

Universal Bevel Protractor used on Lever Feed Table, is graduated in degrees from 0 to 90 each way, and rotates half a circle on a central stud. When used in connection with disc wheel, any angle can be obtained with this protractor.

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2. General fitting and finishing usually done with files and emery cloth.
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5. Close fitting of small parts after machining, soft or hardened.
6. Flattening and straightening bottoms of forged lathe and screw machine tools to make them seat solidly in tool post.
7. Squaring off ends of stock for laying out centers.
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9. Surfacing small steel plates, often used in small jigs, preparatory to laying out holes.
10. Surfacing planed or milled faces of punch and die blanks, preparatory to laying out irregular forms on same.
11. Fitting boring bar cutters.
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20. Rounding ends of small parts to given radius.
21. Finishing periphery of many styles of elliptical and angular cams.
22. Backing off the lands of straightway drills.

Charles H. Besly & Company, Chicago, U.S.A.

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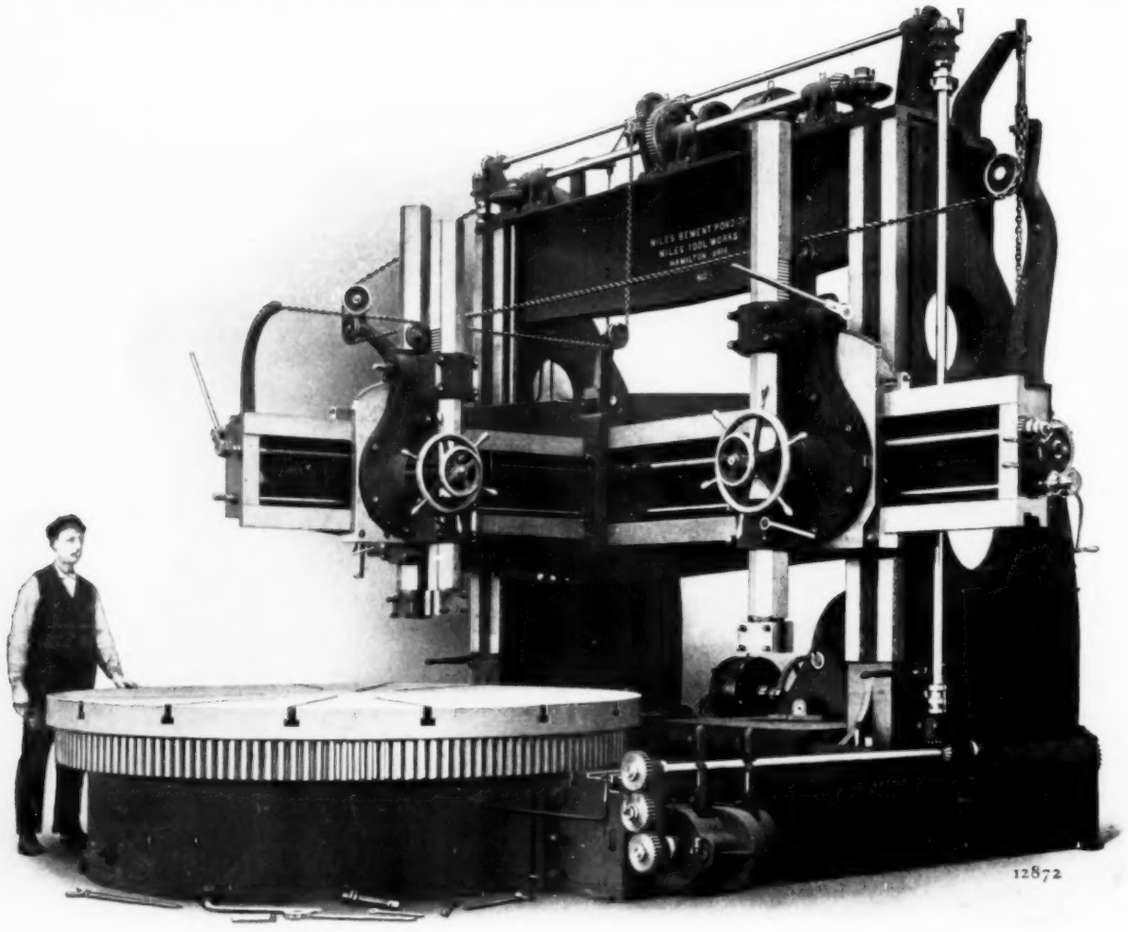
That Cannot be Accommodated on a Standard Machine



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(*See pages* 51, 52, 53, 54, 55, 56, 57 *and* 58)

Tools Used in Making Remington Typewriters

How This New Model Front Stroke Machine Is Manufactured by Means of Accurate Tools, Including Special Machines, Fixtures and Attachments

EDITORIAL CORRESPONDENCE

During a visit which an AMERICAN MACHINIST representative recently made to the works of the Remington Typewriter Company, Ilion, N. Y., he was shown by the works manager, John Calder, and the assistant superintendent, John Montgomery, many interesting special machines and methods, a number of which are illustrated by the accompanying engravings.

Most of the machines and fixtures here shown are used in the manufacture of the Remington new model visible or front-stroke typewriter.

FOUR SPINDLE MILLING MACHINE

The milling machine illustrated in Fig. 1 is one of a number used for machining the edges and guides of the typewriter-carriage frames. The machine has four vertical spindles arranged in pairs, each spindle carrying a gang of cutters, one pair of spindles roughing and the other finishing the carriage frames as they are passed between the cutters. The spindles are adjustable vertically and each pair of spindles is adjustable sidewise by means of worm and worm wheels acting upon eccentric sleeves in which the spindles are carried; and thus the center distance is regulated so that the work may always be held to the exact width required. The spindles are driven by spur and bevel gears from the shaft at the top of the housing.

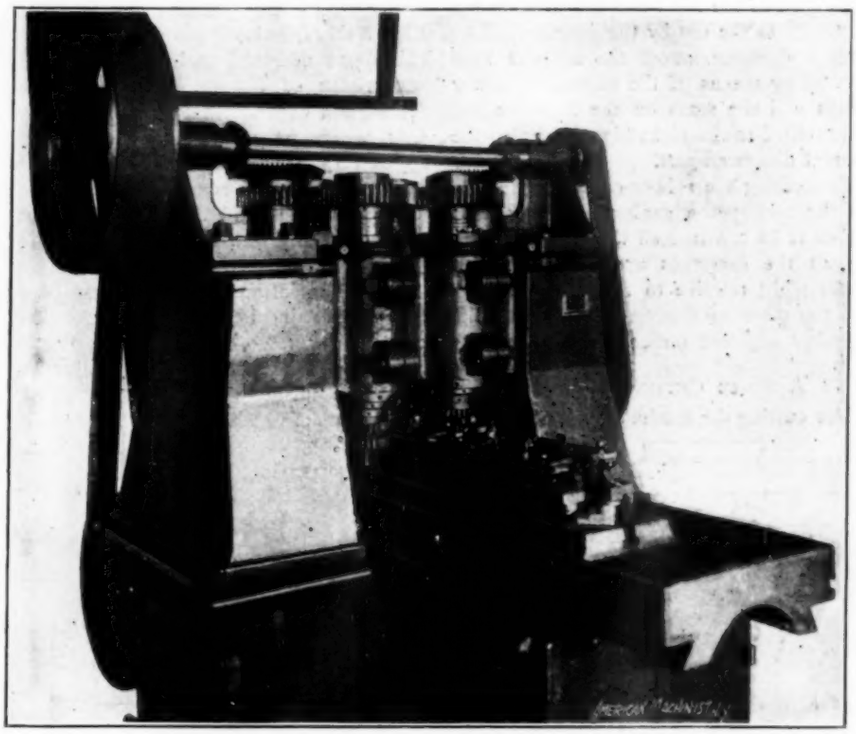


FIG. 1. MILLING REMINGTON TYPEWRITER CARRIAGE FRAMES

The platen is long enough to take two or more carriage frames. The frames are carried by fixtures, the construction of which will be understood from Fig. 2. In this drawing the work is indicated by dot-and-dash lines. The frame when placed in the fixture rests on three points *A A A*, and a pair of spring pins draw it up against stops *B B*. The two screws *C C* press the frame against end stop *D* and the three thumb screws over points *A* hold the frame in its seat. The three pairs of jaw clamps *E E E* are operated by the screws passing through their pivots and are clamped firmly upon lugs cast on the inner edge of the carriage frame.

The two pairs of spring plugs located at opposite sides of the fixture also help to steady the casting during the milling operation. Parts *F F* carrying the thumb screws at either end of the fixture are pivoted so as to be swung down out of the way when the work is ready to be removed, so it is an easy matter to set the castings in place and remove them upon completion of the cuts.

MULTIPLE SPINDLE DRILLING MACHINE

Fig. 3 illustrates a horizontal drilling machine with 42 gear-driven spindles. This machine is used for drilling the cast-iron segments to which are attached the hangers and bell cranks which actuate the type bars. A number of these segments will be seen under the right-hand drilling head.

Underneath the two drilling heads is a longitudinal shaft carrying a pair of cam drums by which the heads are advanced and the drills fed through guide bushings and then through the work. The drill bushings are carried in an indexing head which holds two segments at the same time. While there are 42 bushings in each side of the index head for each of the two segments inclosed in the head, only half of this number of drills operate at the same time on each segment. Obviously the holes are too closely spaced to permit of drilling the entire series simultaneously. The arrangement of the drills therefore is such that after the drills first operating in the segments have finished their work, and the segments are indexed around by the head in which they are carried, the drills then feed forward again and drill the holes between those which were drilled with the segments in their first position. That is at each advance of the drilling head half of the holes are drilled in each segment and when the work is indexed around to the second position the rest of the holes are put through.

A VERTICAL MULTIPLE SPINDLE DRILL PRESS

Another multiple-spindle drill for similar work is illustrated in Fig. 4. In this machine a complete ring which is afterward cut in two to form two segments is placed in the holding fixture, the foot lever is depressed, the holding fixture rises, feeding the work against the drills until the drills have passed through the work; the table then automatically descends, indexes half way round, rises again to the drills and the intermediate holes are put through, thus completing the series of holes required in the segments. The table and work then descend automatically and the machine stops ready for the insertion of another casting.

A TURNING JOB IN THE MILLING MACHINE

A method of facing segment rings is shown in Fig. 5, which illustrates a special fixture screwed on the nose of the miller spindle, and a circular form cutter attached to a block bolted to the table of the

machine. Both work and cutter are rigidly held and a satisfactory surface is thus easily secured.

Two-spindle Milling Attachment

It is very important that the four lugs or bosses which carry the rails for the carriage and are cast on the top plate of the typewriter should be finished to hight and in parallel planes, the two lugs at the front being approximately 3/8 inch higher than the two at the rear. Two of these lugs will be seen at *G G*, in the halftone, Fig. 6; the position of the four lugs, however, is better indicated in the drawing, Fig. 7.

For milling these seats the two-spindle attachment and the holding fixture in Fig. 6 are used. The method of clamping the typewriter in this fixture is shown clearly in Fig. 7. After the typewriter is slipped into place from the front of the fixture, where it rests on four feet which have been milled off in a previous operation, the two gages *H H* are swung around into contact with the vertical faces of lugs *G G* to locate the typewriter correctly in the fixture. The double-ended clamps *I I* which are faced with leather, hold the machine down in the fixture, and jaws *J J* are gripped, by means of the long thumb screws, upon two lugs at the back of the typewriter. The long indicator seen at *K* in Fig. 6 is then placed across two of the bosses or seats at the front which are to be milled, and the flat heel of the indicator brought against the lower end of the buttmill as illustrated. The miller table is then elevated until the indicator pointer shows that the work is at the right hight for the finishing of the seats *G G*, and the typewriter is fed past the two end mills. Only a light cut is taken with each of the mills and the work is fed carefully to the cut by the operator. The overall distance across the mills is kept correct by means of the adjustable cutter heads and the seats on the lugs are not only milled to the right hight, but also the correct distance apart.

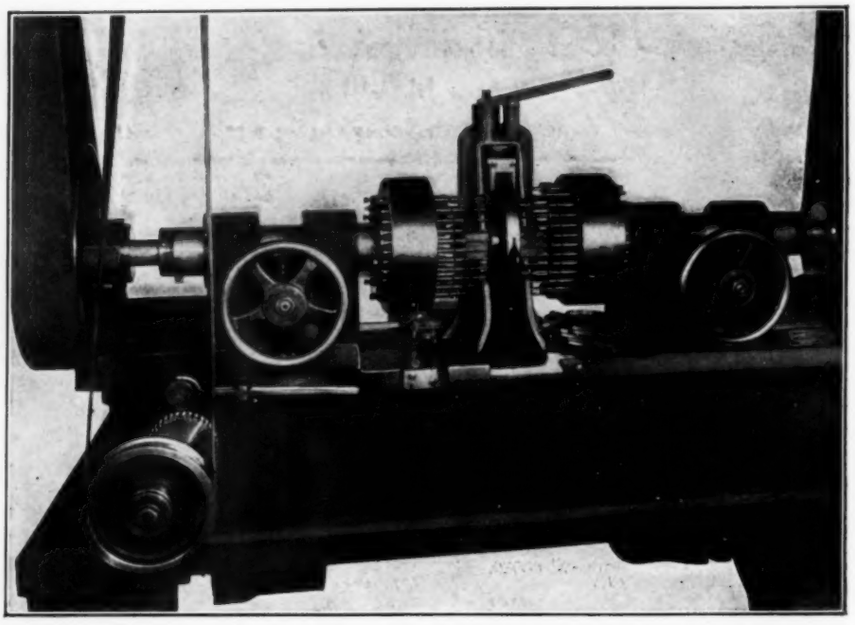


FIG. 3. MULTIPLE-SPINDLE MACHINE FOR DRILLING SEGMENTS

In locating the rubber-covered cylinders on the carriages a gaging fixture is used which is so constructed that the cylinders on all the carriages are brought to an exact hight relative to the rail bosses on the top plate of the machine, and to the type-bar segment under the top plate.

A Scale Cutting Machine

For cutting the graduations on the typewriter scale the machine illustrated in Figs. 8 to 11, inclusive, is used. This machine was designed and built under the supervision of George F. Ballou at the Remington experimental shop, New York City, where, as our readers will recall, a set of very accurate index dials originated by Mr. Ballou was constructed some time ago, these dials and the method of construction being illustrated in our issue of July 11, 1907.

This scale-cutting machine at first glance looks something like a grinder. As illustrated in Fig. 10, four long, bevel-edge strips of brass upon which the graduations are to be cut are secured side by side in the fixture fastened to the work table.

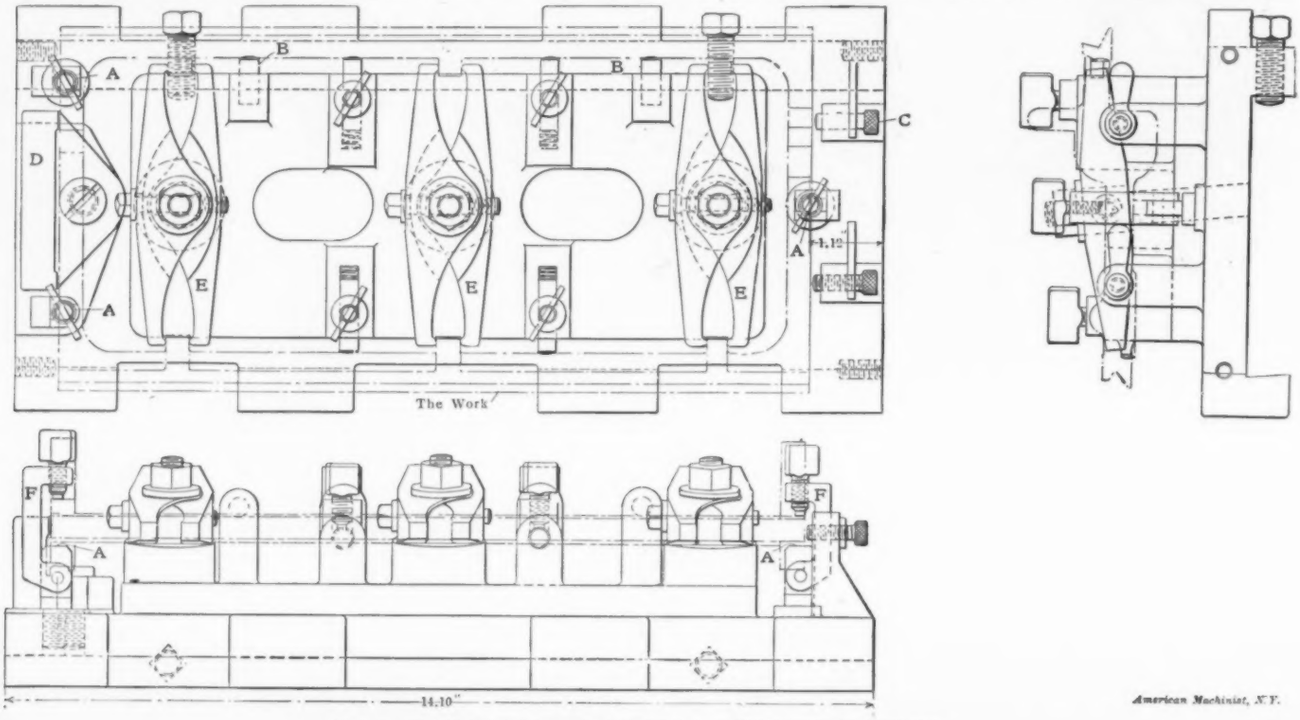


FIG. 2. FIXTURE FOR HOLDING CARRIAGE FRAMES WHILE MILLING

The cutter, which is about ⅞ inch diameter, is geared from the driving shaft, as indicated, and cuts upon the return stroke of the sliding head in which it is mounted. As the graduations are not cut clear across the face of the scale it will be clear that the cutter must rise and fall as it is drawn back over the work. To accomplish this combined clearing and cutting movement the guide or cam shoe at *A* is employed, the face of this shoe being constantly

FIG. 4. MULTIPLE-SPINDLE MACHINE FOR DRILLING SEGMENTS

engaged during the cutting stroke by the roll *B* at the rear of the pivoted cutter head. The reciprocating slide *C*, which carries the cutter head, is actuated by suitable mechanism at the rear of the machine. As the slide is drawn back, roll *B* following the path on the face of *A* allows the cutter to mill a certain distance across the face of the work, then lifts the cutter clear, drops it for the next piece and so on. As the cutter head starts forward the latch *D* engages the lever *E*, pulling that lever down and the cutter up until the cutter head has reached the end of its forward stroke. Referring to Fig. 11, it will be seen that latch *D*, which is normally held forward by a spring, is thrown back by the action of the wedge *F*. This is so located that it strikes the roll carried by latch *D* and forces the latter away from lever *E*, Fig. 10, when the cutter head is in the extreme forward position. Thus the head is released and roll *B* brought again into contact with the cam shoe *A*.

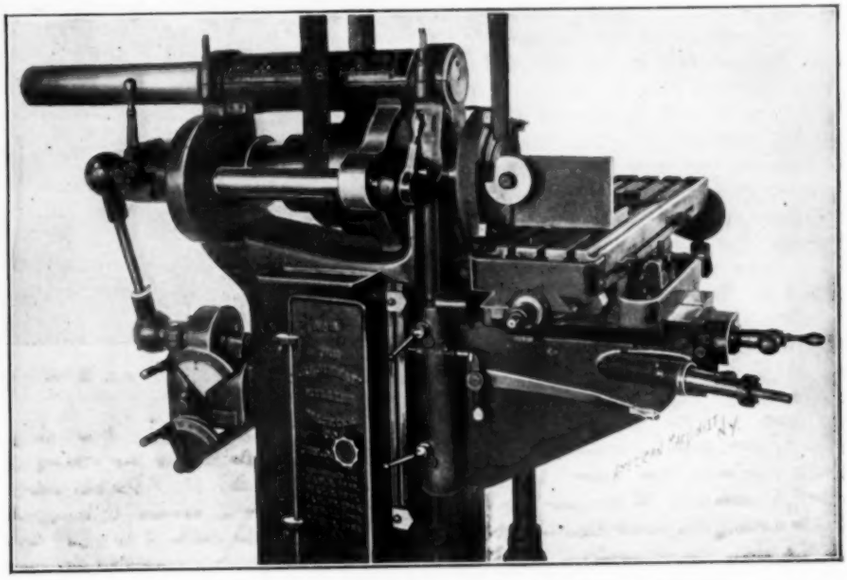


FIG. 5. A FACING AND FORMING JOB IN THE MILLER

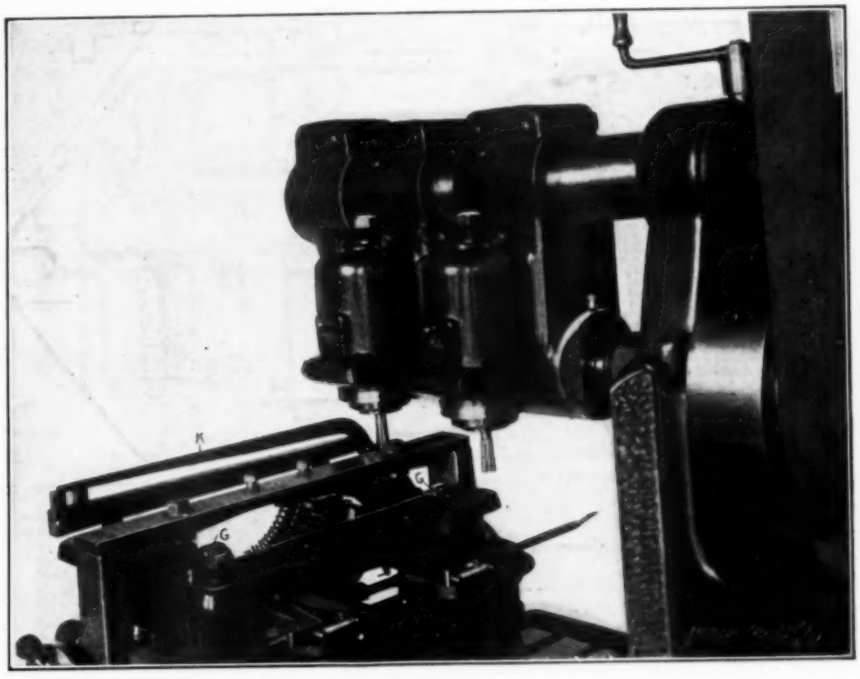


FIG. 6. MILLING FIXTURE FOR TOP PLATE RAIL

THE TABLE MOVEMENT

The work table is fed along, that is, it is indexed longitudinally for successive graduations by rack and gearing indicated in Fig. 10, the gearing being operated by ratchet and pawl, shown in plan in Fig. 9. The ratchet wheel *G* is actuated by pawl *H* carried forward upon the forward stroke of the cutter head by arm *I*, which contacts with a roll under the pawl carrier. Upon the return stroke of the cutter head a torsion spring coiled about the hub of the carrier swings the pawl back until the carrier strikes the stop screw *J*, which limits its backward movement. The position of stop *J* is determined by the graduated sector *K*, which is set to suit the number of graduations per inch required on the scale. The graduations vary, of course, with the size of the characters on different typewriting machines and a series of ratchet wheels are provided which, in conjunction with the various settings of sector *K* determined by the graduations give all of the different

table indexing movements required for the various scales cut on this machine.

Lines of Different Lengths

Referring to the detail of the scale in Fig. 10, it will be seen that the inch line runs nearly the full width of the scale and the ½-inch lines about three-fourths the face width, the others being only about half as long as the full inch line. This means then, that the cutter has to be lifted from the work at different points for different lines of the scale. That is, in each section one inch long on the scale there are three lengths of line and, therefore, three different positions at which the cutter head must be picked up to free the cutter from the scale. This is accomplished by the ratchet wheel *L* and disk *M*, operated by a pawl as the slide *C* is reciprocated. This disk, as will be noticed, has at *N* and *O* two recesses with adjustable stops against which the roll at the back of the guide shoe *A* can drop as the disk is rotated. For each stroke made by the cutter the ratchet wheel *L* and disk *M* advance one tooth. While cutting the short intermediate lines on the scale, the controlling roll *P* rests upon the cylindrical surface of the disk *M* and holds the cam shoe *A* in one position. Upon the stroke for cutting the ½-inch line the disk *M*, which has indexed around until the depression *O* is opposite roll *P*, allows the guide *A* to move backward slightly which means that the cutter will be left in contact with the scale for a little greater distance than in cutting the short lines. As the table indexes carrying the work along step by step past the cutter, dial *M* still indexes with it until opening *N* arrives at the position shown and allows roll *P* and the spring which holds it in contact with disk *M* to set shoe *A*

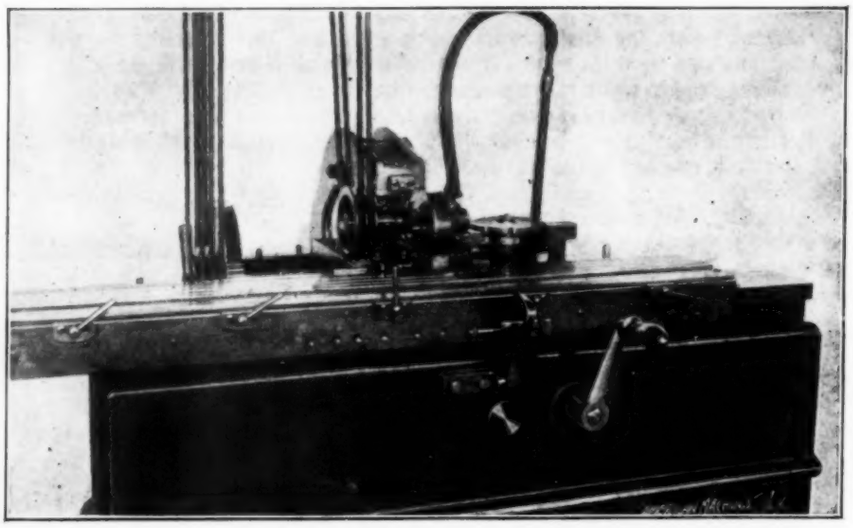


FIG. 8. SCALE-CUTTING MACHINE

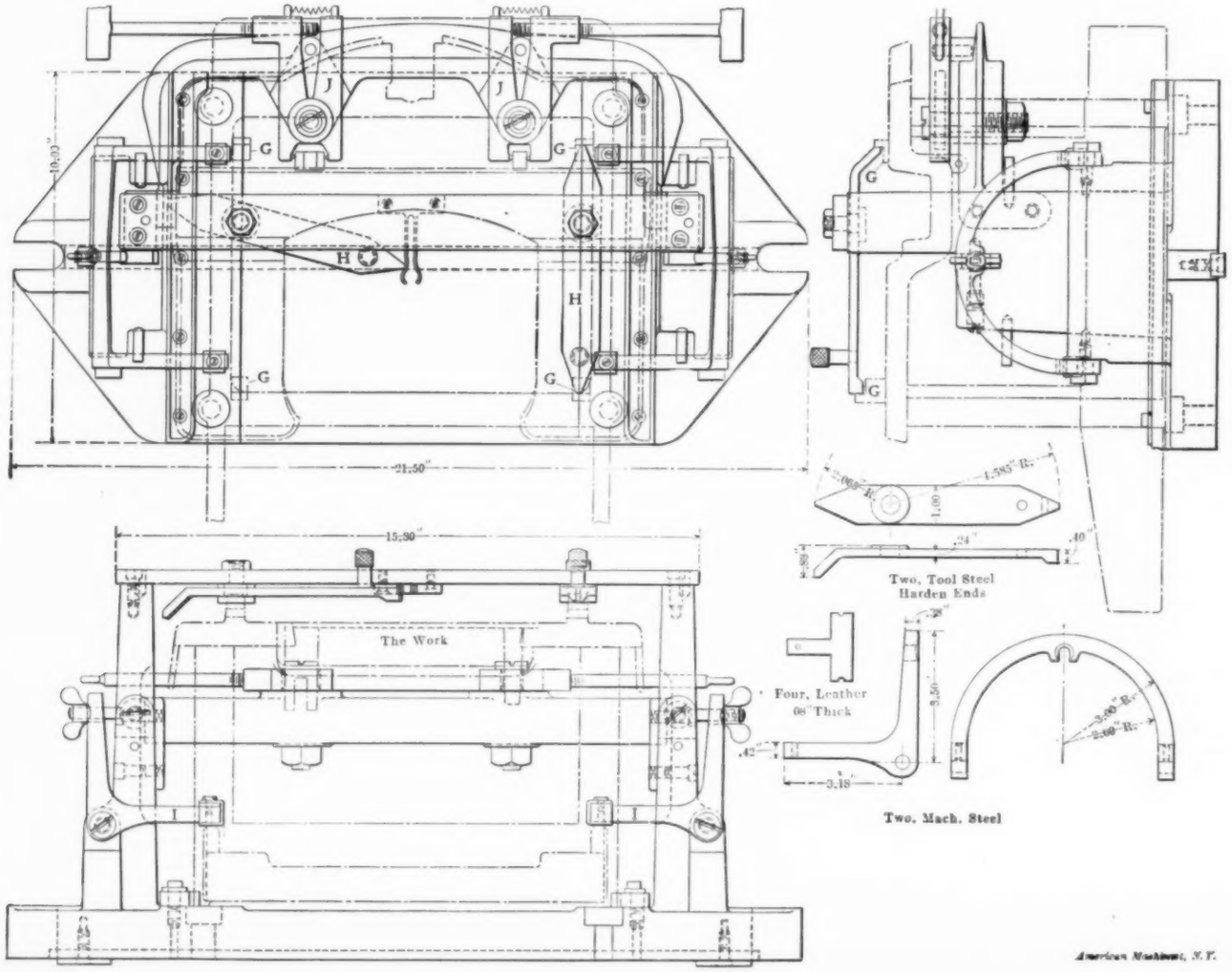


FIG. 7. MILLING FIXTURE FOR TOP PLATE RAIL

at still another point further back or in the right position to enable the long inch divisions to be cut.

Sketches Figs. 9, 10 and 11 are by no means complete, but are intended to show enough of the mechanism to make the principles of operation clear.

A Screw Polishing Machine

The machine illustrated in Fig. 12 is for polishing the heads of screws and aside from the operation of chucking the work the machine is automatic in its action. The machine consists of a rotating head carrying twelve spindles, each of which has a grooved pulley at its rear end and an opening at the front end to receive the bushings for the screws. As the spindle carrier revolves, the screws are slipped into the holes in the spindle mouths by the operator and as they move toward the wheel the spindles are pressed back and the screws are kept in place by a guide at the front with which they are in contact until opposite the face of the wheel. The latter, by the way, is a wooden disk with a face of leather coated with emery. As each spindle approaches the point near the wheel periphery its driving pulley comes in contact with a round driving belt at the rear and the spindle is set in motion. A light spring on the spindle puts sufficient pressure upon the work to insure its securing a proper polish as it slowly passes across the face of the wheel. The dust due to the polishing operation is drawn away by the exhaust pipe shown.

Press Tools for Escapement Wheels

The punch and die illustrated in Figs. 13 and 14 are used for forming the teeth on the periphery of escapement wheels, two of which will be noted in the drawing, Fig. 14. The wheel is blanked out in the form of a disk with an opening at the center and between the three short arms. In the die shown the blank is located over the central pin and two short gage pins which contact with the facing edges of two of the arms of the blank. Upon the return stroke of the punch after the teeth have been formed the wooden handle shown projecting from the front of the die is pressed by the operator to force blanks off the stops, and a puff of compressed air then blows the work and scrap punchings off the die, leaving the latter clean for the reception of the next blank. Fig. 14 shows all the features of construction very clearly.

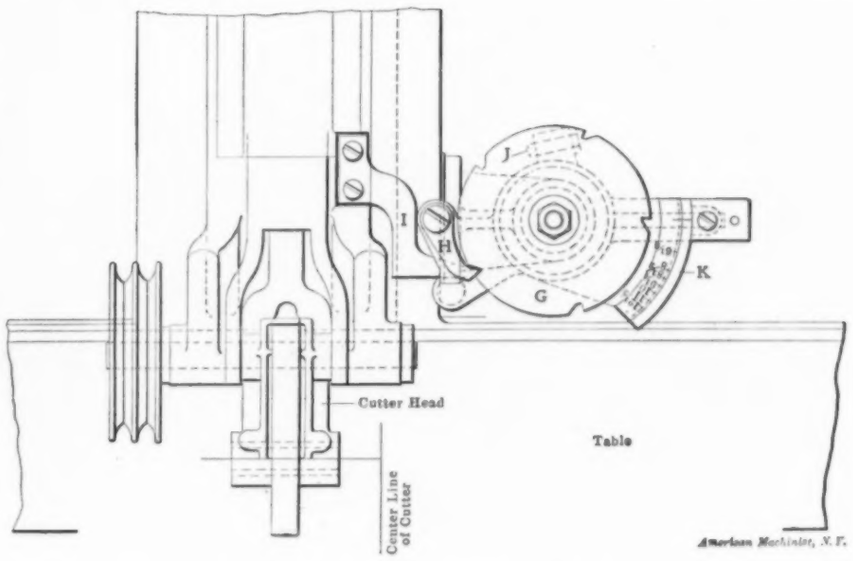


FIG. 9. PLAN VIEW OF SCALE-CUTTING MACHINE HEAD

Some Tool Room Appliances

Naturally there are a good many interesting things to be seen in the tool room at this factory. One of these is the tap-fluting attachment for the hand miller shown in Fig. 15. Most of the taps used by this company are made with rolled threads and they have found this method of threading taps very satisfactory. For all but the smallest sizes the tap threads are roughed out by a die and then finished to size by the rolling process. Also, many of their taps are spiral fluted and it is for this fluting operation that the fixture shown is employed. The spindle is equipped with draw-in chucks for holding the taps, and has a worm wheel at the rear end by which the tap is rotated as it is advanced and which also acts as an index wheel to secure the required number of flutes; the worm which operates this worm wheel also rotates a smaller wheel at the bottom which by means of a screw advances the head and work under the cutter. As illustrated the fixture is so designed as to permit of swiveling to any

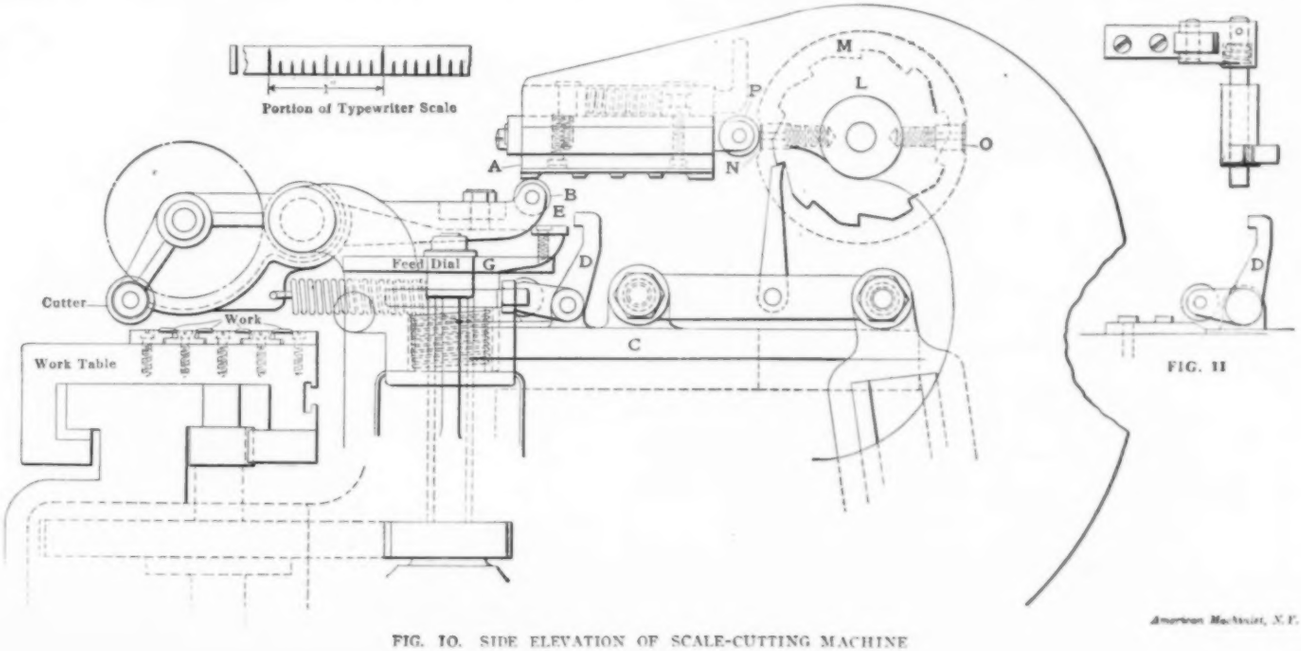


FIG. 11

FIG. 10. SIDE ELEVATION OF SCALE-CUTTING MACHINE

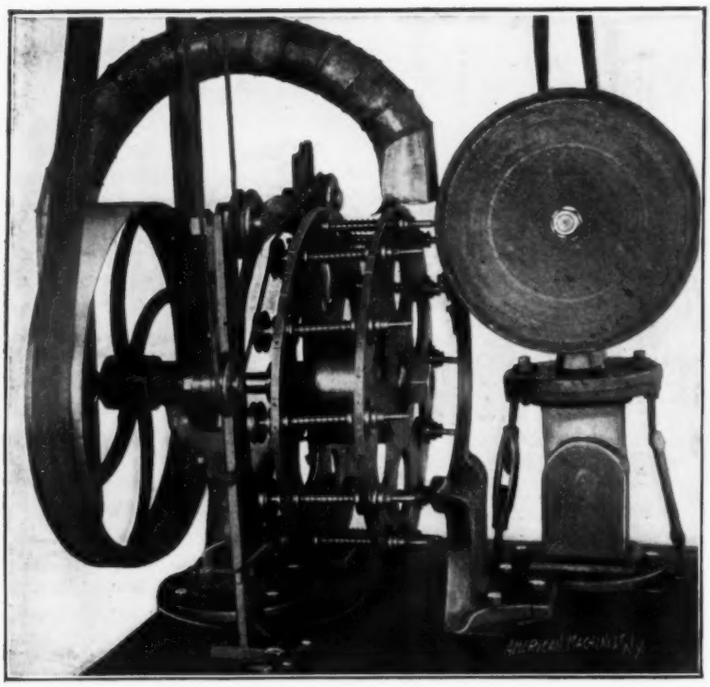


FIG. 12. SCREW-HEAD POLISHING MACHINE

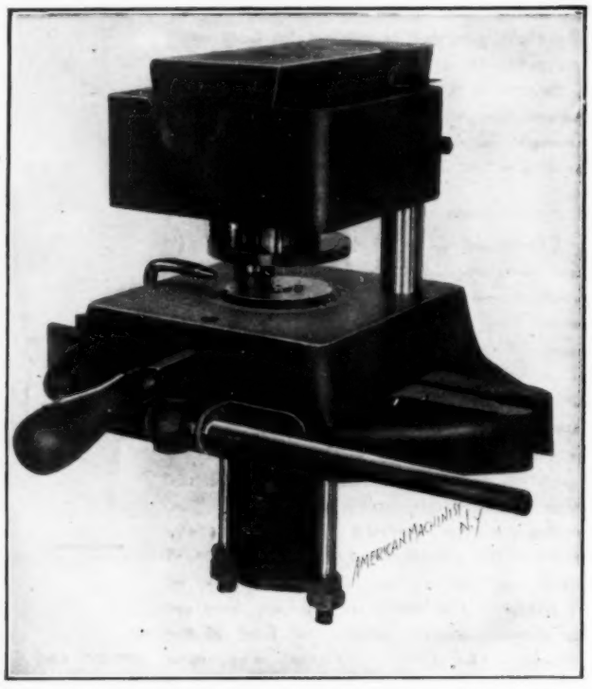


FIG. 13. PRESS TOOLS FOR PUNCHING ESCAPEMENT-WHEEL TEETH

desired angle horizontally and the spindle head may be set at an angle in the vertical plane if so required.

A Thread Test Indicator

Fig. 16 illustrates a handy bench instrument designed for testing the accuracy of the lead of taps and other threaded work. This device has a V-block in which the threaded piece may be placed for inspection and directly over this V is a male V-point to the left of which is an indicator arm whose contact end is exactly ¼ inch from the sharp V-point when the indicator pointer is on the neutral or central line of the graduated scale at the top of the instrument. This device when the contact points are brought down to the work then tests a tap or threaded piece over ¼ inch of its length and any error in the lead in that distance is readily

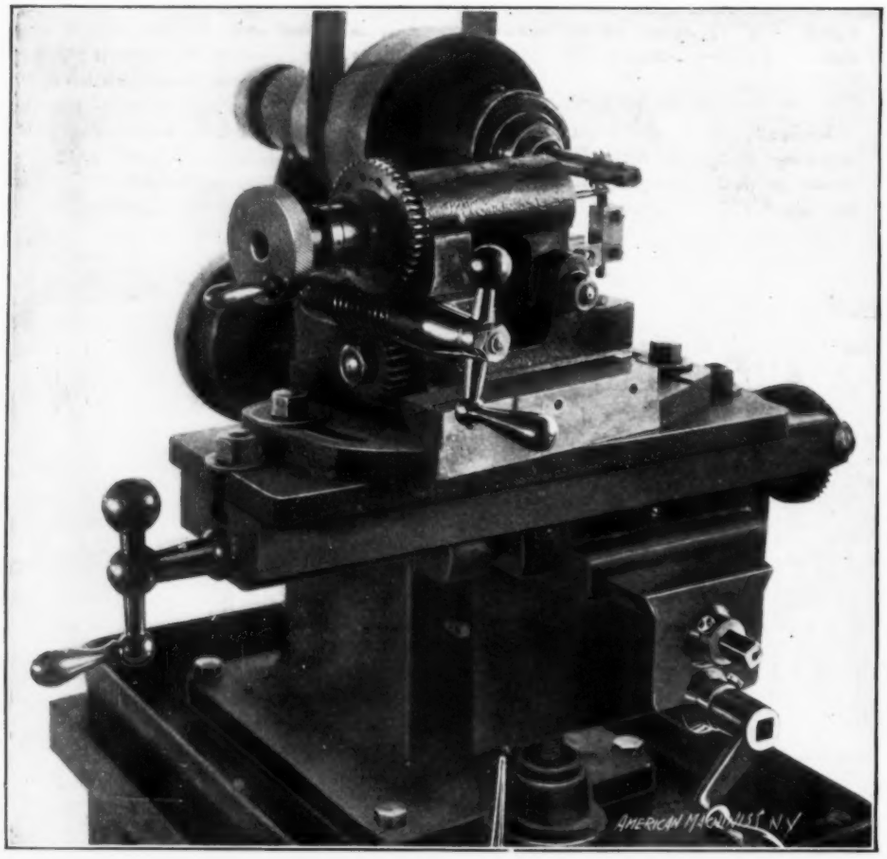


FIG. 15. TAP-FLUTING FIXTURE

FIG. 16. TEST INDICATOR FOR SCREW THREADS

discovered by watching the indicator pointer.

Thread Tool Devices

The tool to the left in Fig. 17 is a fixture used in grinding thread tools on the side to get the angle and on the edge to secure the required width of flat. For determining when this width has been obtained the micrometer gages at the right in Fig. 16 are used. Here between two hardened and lapped steel blocks is formed a V-gap to receive the thread tool, an opening at the center permitting the spindle of the micrometer head to project through and come in contact with the edge of the tool being tested. This micrometer head is so fixed that when the end of the spindle exactly coincides with the apex of the V the micrometer spindle is at zero. The amount to be ground off the edge of the tool to give the required width of flat is readily determined by a simple calculation, and to determine if this amount has been ground off the tool the micrometer spindle has merely to be run forward until it comes in contact with the flat on the edge of the tool.

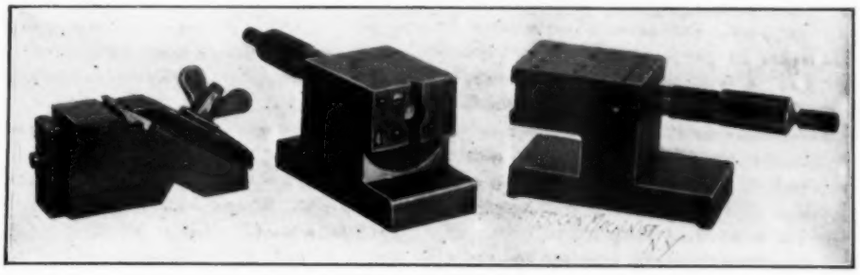


FIG. 17. THREAD-TOOL GRINDING AND GAGING FIXTURES

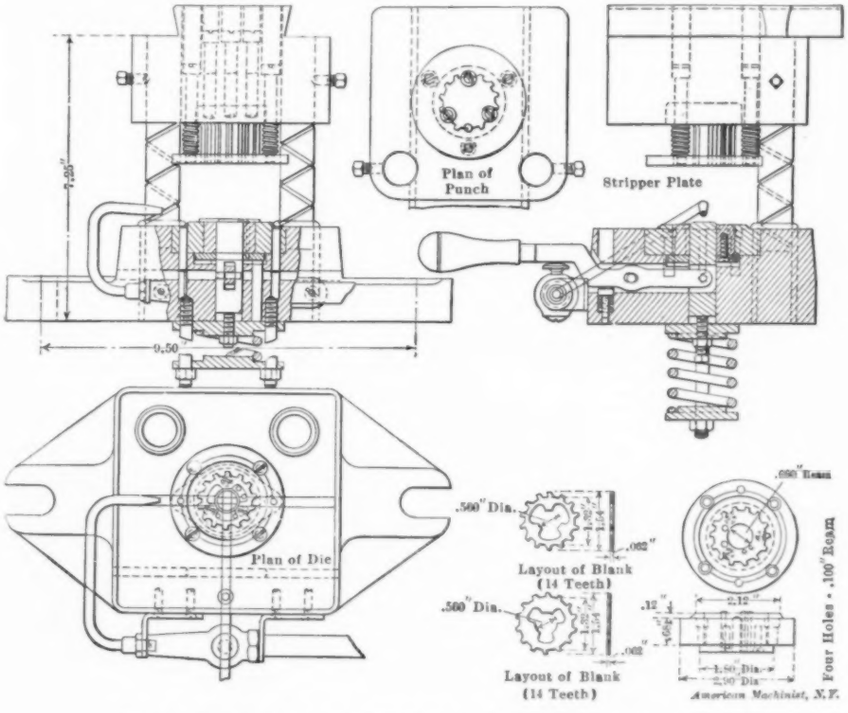


FIG. 14. PRESS TOOLS FOR PUNCHING ESCAPEMENT-WHEEL TEETH

An English correspondent writes: Latham won a prize of £100 and the *Manchester Guardian* cup for the slowest flight on Friday Oct. 22 with his Antoinette aëroplane at Blackpool on the Lancashire coast. He made the circuit in 4 minutes 45 seconds at an average speed of 25.09 miles per hour. The point was, that the flight (two circuits) occurred with a wind at a minimum of 28 miles an hour rising to 45 miles, when no other aviator would make an attempt.

Why the Manufacturers Dislike College Graduates—Another Side of the Question

By Entropy

If I could, I would believe that the simple solution of the technical-college graduate problem offered by Mr. Taylor at the meeting of the Society for the Promotion of Engineering Education, and reported at page 640, was all sufficient. I like simple solutions of complex problems even if some rough riding across established precedent is necessary, but I like them to be solutions. In this case Mr. Taylor apparently has forgotten the rest of the engineering graduates who are not directly dependent in any shop for their livelihood. In my own class 72 per cent. of those living today are not in shops at all, even as superintendents, or managers, or in any capacity.

I do not know of but one school that is today fitted to make, or is making, a specialty of production engineers; and yet it is with that class of men that Mr. Taylor, and incidentally Mr. Crane, are dealing. There is something the matter with our engineering schools, a number of things are wrong, but no man can rectify those things at a breath. Some of those things are mentioned by Mr. Taylor, more are not.

Why are graduates uncomfortable the first two or three years? For one thing they are not; at least, not all of them. Of the class with which I graduated over 50 per cent. settled right into the harness without a whimper. I was not one of that 50 per cent. But college discipline, or lack of it, had nothing to do with my uneasiness. I simply fell into the wrong hole. I could no more fit there than a square peg will fill a round hole. I simply did not fall out, that is all. The rest of the disgruntled ones were in about the same fix. We had the advice of one of the eminent engineers of Manhattan island to take the first job we could get. Those of us that followed that advice suffered. Those that thought they knew what they wanted to do and stuck to it until they got it, have pretty generally stuck since; more than 40 per cent. have not changed the kind of job since they graduated over 15 years ago, and fully half of that number have not changed employers except as they may have been bought out.

Our unrest, then, was no fault of the school, nor would any amount of good advice from our professors have counteracted that one thoughtless remark from the aforementioned eminent engineer.

Discipline—School and Shop

As for discipline: We went out, most of us, to jobs where there were no time clocks, where our employers wanted results, not time. Many of us could truthfully say that the harder we had to work the less we were earning. It was the duty of several of us to keep things moving and our employers preferred to see things moving smoothly while we stood still, to seeing everyone else standing still while we worked.

I believe that the school system of a certain percentage of cuts should be done away with, but to adopt a rigid accountability for time spent would be a step the wrong way. I believe in accountability for results, not time. If a student prefers, as I do myself, to work when

things are quiet in the middle of the night, I think he should do it. I believe that all that any reasonable employer wants is results, and if his head draftsman takes a day off to go fishing and brings back an idea that saves $10 a day I believe he has earned his pay.

The problem, then, is to make boys feel their responsibility. They come to college with no idea of thinking for themselves, nor of doing anything they are not forced to do. These are not natural but acquired defects. They come from a defective system of public education superinduced by a surplus of petticoat rule in our school houses. A woman who wants a child to get a tenpenny nail says, "Go to the back lower corner in the left-hand side of the right-hand second drawer and open the box you find there and get me a tenpenny nail." A man says, "Get me a tenpenny nail; you know where I keep them."

In the first case the boy has to remember a lot of instructions; in the second he has to think and observe for himself. The first reform in engineering education that I would suggest, then, is that our young men be encouraged to marry the schoolma'ams before they can do any harm, and then teach school themselves.

Assuming Responsibility

When these boys escape from petticoatism they are at sea without a rudder. They do not dare to do anything without orders; from that they swing to license and do nothing that they know they ought. Then they vibrate between the two sides of the question, and not all of them come to rest before they graduate. The best that can be done is to put the responsibility for results on them, leaving them free to cut if they think they can afford to. Some of them find themselves caught badly, but the lesson is a good one. If the man in charge is not too inflexible they will learn fast.

If the man in charge is like one of whom I know and who thinks that the business world is absolutely inflexible, then he will be unjust and his boys will not learn to shoulder responsibility, but will spend their time quibbling over interpretations of rules. These boys go out, some into shops where no cuts in time are allowed, others outside on the road where there is no one to keep tabs on time but plenty at home to keep tabs on results. These boys realize the value of the rope with which they were allowed to hang themselves in school. Those who go into the shops may, and doubtless do, find the hours irksome, for when a fellow is young and elastic he can do all the brainwork there is in him in a very few hours per day, and it takes him a year or two to curb his enthusiasm, so that he can spread his energy over eight or ten hours a day and make it look as if he was hustling all the time.

I cannot agree with Mr. Taylor that young men do not know what commercial life is like. There may be schools where rich men's sons congregate, but my experience has been with schools where eight out of ten boys are in some substantial degree earning their way. They know what a dollar costs. They know that a dollar earned does not always mean a dollar to spend. They know that they will have a lot to learn after they graduate, and whether Mr. Taylor believes it or not, they will learn.

I remember a certain two weeks in my last school vacation. I worked in a little hole of an office where the sun poured in so that the boss could not stand it. I put in my time for 15 cents an hour under a graduate of the Baldwin Locomotive Works, and I learned more machine design in those two weeks than in the same time before or since.

Why did I stick it out? For the money. I needed it. Would I have done the same thing in school? Not a bit of it. I tell you it is money that disciplines the man, through his necessities, but I believe that vacation money is just as good a discipline as any other. Just so long as a boy can feel sure of remittances from home, Mr. Taylor cannot make anything out of him in his shop. When he gets down to his last dollar, then his education in responsibility begins. The school cannot impose any such conditions.

My next suggestion for the improvement of engineering education is that the parents of the students be prohibited sending too large remittances to their boys.

Shop Work During the Course

Mr. Taylor suggests that every boy should be compelled to leave college at the end of his first year for a year's shop experience, and then come back to finish his course. The trouble is that these boys who might go into the shops would still be drawing on their parents for what they would consider necessary funds; they would not be dependent on their wages, and outside of shop hours they would be under no restraint whatever, and Satan finds more mischief for idle hands after 6 o'clock than before that hour.

Many people who see college men out larking by daylight think that therefore they never work. The average college boy finds his day's recitations over in the middle of the afternoon. He takes his recreation then and until after supper. Then it takes him until 9 o'clock to settle down to study, but then he is good for three hours of solid work. He works, if he is going through any kind of form, as many hours a day as any growing man ought to attempt. After he graduates he finds the hours bothersome for a short time, and he knows no more what to do with his evenings than he did 10 years before with his hands. This is no discredit to the schools, and the fact that he usually settles down in short order is to his credit.

As for a shop as a place to learn character, I fail to see it. The surroundings are not conducive to right thinking. To be sure they may have to do many things that they would not do if they had their own way, but that is just what they have been up against all their lives. It is nothing new. We like to think of college boys as being pampered, hare-brained youth, but I doubt if there is much foundation for it in the engineering schools. Those that I have met have impressed me as being no more wild than the board of alderman that go off in a junket, or even than a lot of priests that I once sailed down the Saguenay river with.

They are boys with animal spirits intensified by the high pressure put on their intellects. They nearly all make good when they are old enough to settle down to routine. Very few men are settled enough in their thoughts before they are 25 to take positions where they have much responsibility. These boys graduate at 22. Is it any wonder that manufacturers prefer that they should work for someone else those intervening years? If they could come out of school matured and ready for serious work it might mean a gain of two or three years of a life of earning for them, and then again it might cut off five years from the latter end of that life.

Of the two I believe that the colleges attempt to do too much with and for their boys. It would be better to do less, a little more thoroughly, but still less, so that the boy might have time to let that much soak in. Boys go through school today in a daze, a trance; they no more appreciate what they are doing than a man coming out from under the influence of ether knows what he is doing. This is a fault, and a real fault, with schools today.

Professors and Instructors

Time was when a college professor was a man who left the impress of his personality, his character, on his pupils. Today he may have all the character and personality of his predecessors, but he coops himself up in his study writing learned treatises that no one ever reads except by title, while his work is done by underpaid, body- and soul-starved instructors. I would suggest as another improvement in colleges that the instructors be fired and the professors be dug out of their dens and set to professing directly to their students. Of course, that would mean much less student time given to each subject, but 10 minutes' time each day in personal contact with a man who knows is far better education than 10 hours with a man who only thinks he knows.

Many men have proposed this scheme of having boys get out in the world before they finish their education, but those of us who have seen it tried will not vote it an entire success. We have seen boys come back to school after a year or years of shop experience, always with the same assurance, that now they know what they want, but after a week or two the only difference there is between the boy who

has been in the shop and the boy who has not is that the boy who has been out cannot get down to study evenings.

IF YOU FOLLOW YOUR BENT, WORK IS NOT DRUDGERY

Drudgery! Must every one be a drudge? I don't believe it. To be sure Mr. Taylor's methods of shop management would tend to make it necessary, but they are not likely to be very widely adopted in our day. I don't recall having done any appreciable amount of drudgery since I left high school myself. If you are interested in your work there is little danger of its becoming drudgery. If you are not then you are in the wrong pew.

One of the very best lawyers and one of the very best doctors in this city tried to learn the machinist's trade when they were boys. They both gave it up because they could not stand the drudgery. Now I cannot imagine any greater drudgery myself than getting into law or medicine. It is all according to what you are fitted to do.

To be sure, if our shops get so that every new man is submitted to the Bertillon measurements and then fitted to certain machines and kept there doing what he is told to do by the tool boss, and the drawing boss, and the gage boss, and the speed boss, and the feed boss—well, what's the use? I am talking about machine shops anyway, so why digress?

And then it is only prophesying to say that just such a lecture as Mr. Taylor's will probably be applicable 10 years from now. As I said before, there is only one school that I know to be intentionally fitting its graduates to become production engineers. The field is large, but for an engineering college to attempt it looks to me like going after snipe with a cannon. I believe that that is a field which can be much better covered from the lower side by the bright men from our newly arriving trade schools. If the trade-school idea is carried out, as I believe it should be, it will produce a new crop of men skilled of hand and yet keen of eye and mind who will have more interest and a better point of view to tackle shop problems than all the professional engineers that the colleges can turn out. More than all this, there are fully as many bright boys outside our technical schools as in.

I went through a shop a few days ago where I could not help noticing boy after boy, or young men, I ought to say, whose faces showed them to have capacity for education far beyond what they had. These boys never will have a show in the technical schools because they will not reach out and down for their boys, because being largely dependent on tuition money for their support they cannot afford to. These boys must be reached before our American system of education is complete and today their one best hope is in the trade school.

Bluff Inspection—Worm Gears

BY JOHN R. GODFREY

Whenever I hear a foreman call a man down before his visitors for allowing an imperfect casting to go through with a lot, or in loud tones and with a voice of authority ordering certain defective parts thrown into the scrap heap, I always think of the story they use to tell of a certain street railway.

Whenever anyone would come into the general office and complain of the unbecoming conduct of any of the employees, the manager would promptly call in a trembling conductor or motorman, as the case might be, and discharge him on the spot. As a matter of fact, these men were hired for just this purpose, and the complaining patron went away with mingled feelings of satisfaction and pity.

In the case of the shop, however, instead of impressing me with the extreme care taken to have everything just right, it usually savors more of a gigantic bluff because if they were as particular as this would seem, the defective castings or other material would have been discovered by the inspector at some stage of the game and thrown out before much machine work had been done on it.

It would either happen this way or the inspector was decidedly not onto his job.

There is also another and a rather disastrous side to so called object lessons of this kind. It cannot help breeding a feeling of distrust for the sincerity of the other actions of the firm and cause an uncomfortable feeling of uneasiness as to how much of the pretended desire for good work or for the welfare of their men, is real and how much simply for effect. They are very apt to allow the idea of pretense to assume unduly large proportions and to underestimate the real amount of good that really exists.

The worm-gear proposition has as many sides as there are advocates of different angles. I ran across a case a while ago of a machine driven by a long spiral or helical gear, say, 4 inches pitch diameter by 48 inches long, to allow power to be taken off at any point. This had been in use a long time and showed very little wear, while the feed worm, with comparatively little to do, was badly worn.

It was easy to lay this to the no-goodness of worms in general until you come to think that the so-called spiral gear was really a worm, the difference being in its rapid lead which gave it a very sharp angle, say, 40 degrees.

This made me sit up a bit and note other worms and it soon showed what we all ought to have known, that a worm with a fast lead giving a sharp angle to the thread, not only gives much better service than one with a small angle, but it makes a form of power transmission that is hard to beat.

This brings us up against the problem of the worm wheel and opens up the endless question of the shape of the worm wheel or whether it shall be hobbed or not.

Professor Sweet points to the Sellers planer with its worm running in a rack, as evidence that hobbing is unnecessary and this certainly seems to make good such a claim. I have never yet found a man who ever knew of any trouble from this drive when made with a sufficient angle of lead.

Among many English and Canadian builders of planers we also find a worm and wheel between the driving pulley and the bull wheel, and I've never seen planers that ran better than these. The reverse is easy, the operatic notes in high C from a squeaky belt are noticeably absent and I'm told they give very little trouble. It is certainly worth thinking about and studying over.

Williamson Free School of Trades

In view of the great interest in trade education as evidenced by the numerous articles on the subject in the AMERICAN MACHINIST, I am quite sure that the inclosed statement will be of interest, as it shows what has been done in this school, and what may be done in similar schools when managed on a *thorough*, business-like plan.

JOHN M. SHRIGLEY,
President.

Record of the classes graduated in 1905, 1906, 1907, 1908 and 1909:

Bricklayers	62
Carpenters	59
Stationary engineers	31
Machinists	62
Patternmakers	54
	268

On November 1, 1909, 266 of these young men were living, two having died, and were engaged as follows:

At mechanical trades as journeymen, foremen, superintendents and contractors	243	91.35	per cent.
At college*	5	1.88	per cent.
At commercial pursuits	15	5.64	per cent.
No information	3	1.13	per cent.
	266	100.00	per cent.

*Four of those at college worked for considerable time after graduation at their trades, and the two who died were doing the same.

The average wages being received by these graduates are as follows:

Bricklayers	$4.64	for 8-hour day
Carpenters	3.84	for 8-hour day
Stationary engineers	3.60	for 10-hour day
Machinists	3.28	for 10-hour day
Patternmakers	3.10	for 10-hour day

Exports of iron and steel, including machinery, from the United States for the eight months ended Aug. 31 are valued at $105,258,962 in 1908, and $100,055,684 in 1909; a decrease of $4,303,278, or 4.3 per cent.

Principles and Construction of Aeroplanes—II*

Continued Discussion of Design, Means of Starting Flights and a Summary of Conclusions in Regard to the Trend of Aeroplane Development

BY ANSBERT VORREITER

Both of the double-deckers here compared embody the earlier form of double-decker construction. There may be mentioned also the double-decker of Maurice Farman, a brother of the well known aviator. It agrees with Voisin's form of construction, except that to obtain lateral stability, the main planes, like Wright's, can be warped.

Very similar to the Voisin is also the double-decker of Witzig and Lioré, Fig. 43, in which the three tail planes are placed above each other, step fashion, an arrangement which, with respect to main planes, was first indicated by Kress, at Vienna. By this means the tail planes behave better if, through a stoppage of the motor the aëroplane becomes a glider, because the main planes do not cover them in a vertical direction. The highest tail plane is adjustable. The lower main plane

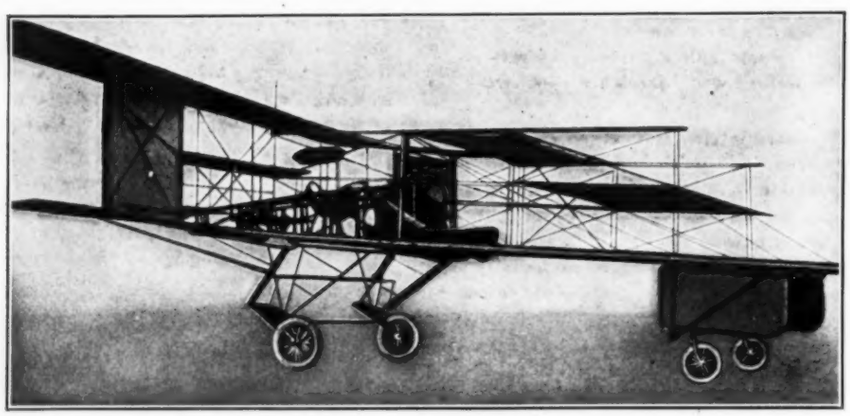


FIG. 43. AËROPLANE OF WITZIG AND LIORÉ

has only half the breadth of the upper, since the middle part and the ends are cut away. The middle part would contribute less to sustaining the machine, since the tail planes lie just behind it.

As an improvement on Voisin's double-decker, may be considered the American Curtiss, Figs. 44 to 46. Curtiss puts the shaft of his propeller in the middle between the main planes and directs the ends of the upper plane downward, the ends of the lower plane upward. Since in downward gliding the lower surface comes into use, Curtiss obtains thereby an automatic stability. For flight, Curtiss employs steadying planes in the form of triangular sails, which are placed on both sides of the main planes, removable about their forward corners. As Fig. 45 shows, these planes are to be turned in opposite directions. If this arrangement cannot be so finely adjusted as Wright's warping, yet it works far better than the steadying planes of Farman placed behind the main planes. The planes used by Curtiss are narrower behind, so that the surfaces become very small as they extend in a backward direction; and moreover, by reason of this triangular shape, they are very elastic. Over Wright's method, that of Curtiss has the great advantage that the resistance of the main planes remains the same on both sides, and the flying machine, therefore, is not forced into a false curve. The steadying planes are actuated by a lever, which branches into a fork; in this the aviator rests with his back and moves the planes right or left by inclining the upper part of his body.

Since, when the flying machine inclines or turns, the aviator instinctively moves his body in that manner, the control of the Curtiss machine ought to be easier to learn than that of Wright's. On the whole, Curtiss' aëroplane is little inferior to Wright's, and in fact, its builder, after comparatively short practice, has performed remarkable flights. When Wright's example was present, these results could, however, be more easily attained.

A double-decker simplified and improved over Voisin's is recognized in the aëroplane of Captain Ferber, Figs. 47 to 49, who indeed, was allied with Voisin Brothers in the construction of their flying machine. For automatic production of lateral stability, Ferber turned not only the main planes, but also the tail planes upward in the form of a blunt V. The propeller shaft, like Voisin's, lies low; the screw, however, is placed *in front of* the main planes. Ferber employs two turning controls placed directly behind the main planes. That arrangement I might recommend, if the screw also were behind the planes, Figs. 50 and 51. This would offer the following advantages: The machine would not be turned out of its path by a side wind, assuming that the center of gravity lay in about the same imaginary transverse axis as that which connects the two turning controls. This may easily be obtained by placing at sufficient distance the tail planes or the controls for altitude, which are at the rear. If, however, the turning control is far back of the main planes, a side wind will turn the machine toward the wind, which nevertheless is not so bad as turning toward the wind when the turning controls are in front of the main planes. The turning control placed at the rear increases the resistance behind the main planes and behind the point of application of the screw. Thus, the turning control automatically acts as a steadying plane, while if it is placed in front, it, like the front control for altitude, may exert a tipping moment—laterally for the turning control and up or down for the altitude control.

When, by stoppage or removal of the motor, the aëroplane becomes a glider, the arrangement of the turning control in front of the main plane acts far more objectionably than a similar arrangement of the control for altitude, and it necessitates continual activity of the aviator. It must be regarded as necessary for gliding that the resistance behind the center of gravity of the machine shall be essentially greater than in front of it; therefore, it is preferable to place the propellers behind the main planes.

Pischof & Koecklin, who formerly, like Blériot, were adherents to the single-decker, have built for Piquerez, of Paris, a double-decker, Figs. 52 to 54, in which several new arrangements are made. Simple is the disposition of the planes for maintaining lateral stability. As usual, they are placed on both sides of the main planes, yet only on the upper one, and the planes are revolvable about an axis which lies parallel to the chord of curvature of the main planes. These steadying planes, naturally, are turned in opposite directions. Let us consider one plane turned so far upward that it is approximately vertical; then it can have no sustaining power and cannot tend to lift that side of the aëroplane. Simultaneously, the other steadying plane hangs almost

*A paper presented to the Berlin section of the Vereines deutscher Ingenieure; translated from the *Zeitschrift des Vereines deutscher Ingenieure*, by E. P. Buffet.

[By way of condensation several illustrations appearing in the original have been omitted.—ED.]

vertically downward. Since the main planes are broader in front than behind, this plane offers a considerably greater resistance to the air on its lower side; it is therefore lifted, and raises the same side of the machine, while the other plane presents a resistance on its upper side and therefore depresses its side of the machine. The arrangement therefore works like the warping of the main planes by Wright and others.

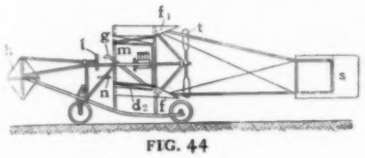


FIG. 44

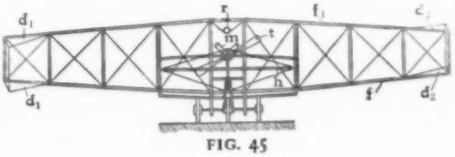


FIG. 45

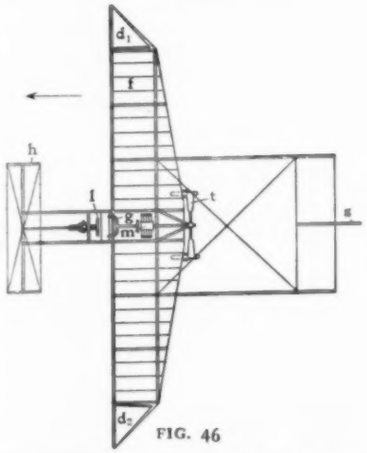


FIG. 46

DIAGRAM OF CURTISS AËROPLANE "RED WING"

Suggestive of Wright is the use of two propellers, which, however, have their bearings in long arms of steel tubing placed on the body of the machine on both sides. The two-bladed wooden screws are driven by chains, yet the opposition in the direction of rotation for one screw is brought about without crossing of the chain; the sprocket wheel not being set directly on the motor shaft, but driven by a gear from the shaft. The motor is from Dutheil & Chalmers, and has four cylinders. At a speed of 1400 revolutions per minute, it produces 40 horsepower; the screws run half as fast as the motor shaft. Dutheil & Chalmers now build motors with two crankshafts turning in opposite directions, especially for driving aëroplanes with two screws. This form of motor construction is characterized by very smooth running.

Noteworthy in this aëroplane is also the control for elevation. Two rudders are employed, one in front, arranged at about the same distance as Wright's, and one far behind, which has vertical planes. This rear rudder is revolvable in a vertical as well as horizontal direction, after the fashion of Santos-Dumont's single-decker, and therefore serves at the same time as a turning control by virtue of its vertical planes. The rear control for altitude has curved planes, since it serves at the same time as a tail plane for maintaining steadiness in the direction of flight. The starting frame has four wheels and is so low that the main planes almost touch the ground.

Since this double-decker is built for two persons, who sit tandem, the supporting (or main) surface is quite large. With a breadth of 35 feet all the [main?] planes together amount to 840 square feet. The length of the flying machine amounts to 35 feet, the weight with two persons about 1320 pounds. Therefore, the load is about 1.7 pounds per square foot of supporting surface.

Guyot & Jaugey, Fig. 55, built a double-decker similar to the new Farman. Noteworthy in the same are the lateral steadying planes. They are placed on both sides on the outside vertical struts of the main planes, somewhat below the center. The inner edges of these planes are fast connected with the struts. The outer edge may be warped by being pulled with a vertical rod which crosses it in the middle and is held by tension wires joining its extremities to the main-plane ends. By cords which run over rollers on the corners of the main planes above and below, and are connected to a foot lever, the steadying planes may be so warped that, for example, the front edge of one is raised and the lower edge depressed, and contrarily for the plane on the other side. The two-bladed propeller is placed in front of the main planes and journaled at the rudder for altitude, which stands very close in front of the main planes. The control for altitude is actuated, as in Voisin's flying machine, by a back-and-forth movement of the shaft of the steering wheel; the turning control by revolving of the shaft. The motor produces 36 horsepower, and is built by Mors. The main planes have, for a breadth of 26 feet, about 506 square feet of surface. The starting frame is built very high, and has two small wheels in front, one in the middle under the main plane and two more behind at the tail plane.

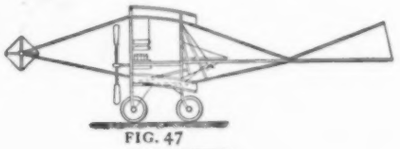


FIG. 47

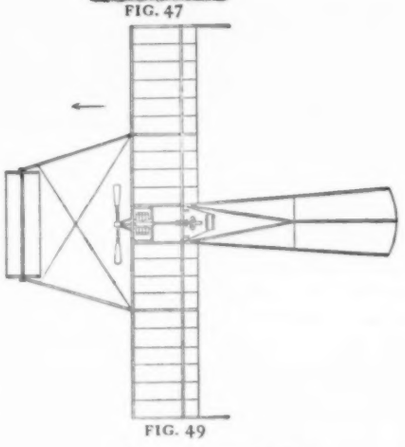


FIG. 49

AËROPLANE OF FERBER

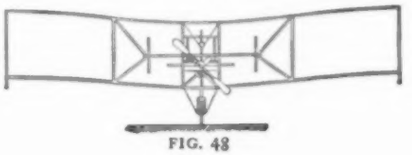


FIG. 48

Analogous to Wright's flying machine are also the double-decker of the German technician, Schüler, Fig. 56, and further, the double-decker of Captain Cody, Figs. 58 and 59, which was built for the English army. To produce lateral stability, Cody now uses planes arranged right and left between the main planes, and pivoted about horizontal axes lying transverse to the direction of flight. They work far less smoothly than the corresponding devices of Wright or Curtiss, and the flying performances of this aëroplane are not very remarkable; it is wrecked after almost every ascent. Therefore, the Wright patents have now been purchased for the English army.

Among double-deckers may be mentioned Blériot's, Figs. 61 and 62. It deserves attention because Blériot was formerly an adherent of single deckers. The fact that after having built some 10 single-deckers, he has gone over to double-deckers must be attributed to the results attained by Wright brothers. Suggestive of Wright is the low build of the main planes, which are only a little above the ground. This arrangement has the advantage that landing is very soft, because air is compressed between the lower plane and the ground. Although Blériot adheres to the starting wheels characteristic of French aëroplanes, he makes them very low and dispenses with a spring frame, such as that of Voisin, for example. Therefore, the wheels are shod with comparatively strong pneumatic tires.

Notable is the arrangement for control of elevation, which in the double-decker of Blériot serves at the same time for maintenance of lateral equilibrium. On each side, behind the main plane, is a rudder for elevation. As shown in Figs. 61 and 62, both planes may be turned by the same lever in a similar or opposite direction. Turned in the same direction, by forward or backward swinging of the lever, the planes act for control of elevation; turned in opposite directions, by right or left movement of the lever, they act as steadying planes, because then one plane is raised in front and the other de-

pressed. In the experiments this control worked quite well. Notably, Blériot places the turning control in front of the main planes; furthermore, he places behind the main planes vertical planes to which the stays that hold the rudder for altitude are stretched in triangular form. By pressing on these planes a side wind turns the flying machine in the wind's direction; since, however, the forward turning control has a far longer lever arm, the influence of its surface preponderates. Between the main planes are also two vertical planes, which are intended to maintain lateral equilibrium automatically, as in Voisin's machine. They, however, increase the surface exposed to side winds, and, therefore, this aëroplane is carried considerably out of its path by such wind. In order to maintain the desired path of flight independently of side winds, it is desirable to diminish the vertical planes, as Wright brothers have very correctly understood.

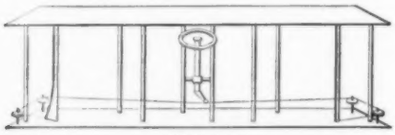


FIG. 50

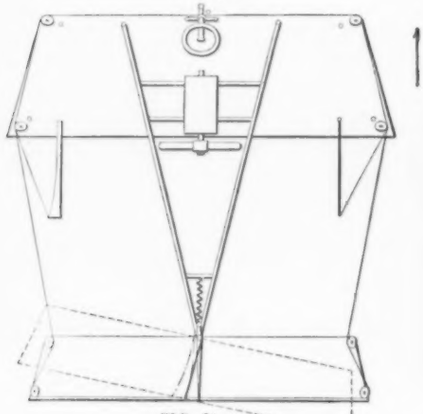


FIG. 51

American Machinist, N.Y.

AËROPLANE WITH THE PROPELLER AND TURNING RUDDER IN THE TRANSVERSE AXIS CONTAINING THE CENTER OF GRAVITY

Their flying machine has only the turning control as a vertical surface, and two small semi-lunar guide planes between the planes of the rudder for elevation.

The vertical planes between the main planes have, in Blériot's case, still another purpose: they cool the water for the motor.

The propeller is journaled in the middle between the main planes, and its shaft is parallel to the chord of their curves. Since the rudder for elevation is placed somewhat above the middle, the flying machine is automatically inclined toward the direction of flight, and the main planes therefore assume the angle of incidence. The propeller is driven by a chain which reduces the speed; therefore it appears that Blériot has become convinced that the slow propeller has greater efficiency since his single-deckers were always driven by propellers directly placed on the motor shaft.

In the shop of Blériot, a second double-decker was built, which is noteworthy because the two main planes are not vertically superposed but the lower one is set back. Apparently the intention in this arrangement is to increase the buoyancy of the plane in gliding. It possesses, however, the disadvantage that in flying, the air current diverted downward by the upper plane impinges upon the lower more than it does as the planes are usually arranged. In order to remedy this defect and attain the object already mentioned, the upper plane should be set back instead. Lateral stability is attained in the same manner as with the already described single-decker of Blériot, through adjustable planes, placed at the rear on both sides of the tail plane. The propeller is set forward and is directly driven by the motor. The aviator's seat is quite a long distance behind the motor. There is no advantage in that. It will tend to increase vibrations in the flying direction, about the center of gravity of the machine. Endeavor should be made to place all the heavy parts as near together as possible, which Wright has done. In Voisin's machine the aviator sits directly before the motor.

An approximation to single-deckers is formed by those aëroplanes in which the upper main plane is extended as a rudder for elevation. The first who practically entertained this idea was the German Jatho. First, he built his flying machines as three-deckers, later he removed the top plane. Jatho endeavored to obtain lateral stability by the low position of the center of gravity. As shown in Fig. 64, the motor and seat of the operator are therefore placed considerably below the under plane. The fault here is, that a side wind blowing strongly upon the vertical planes and rudder for turning, between the main planes, converts the machine into a lateral pendulum. Pendular movements also enter in the direction of flight; and the more so since these motions are not dampened by any tail plane placed remote from the main planes. The propeller, at low gear, works behind the main planes somewhat below the center of resistance, so that the main planes automatically assume the angle of incidence. Whether power transmission by belt is advantageous must be doubted. In automobiles, belts for this purpose have not commended themselves, since they are susceptible to weather and moisture. Materials used for covering the main planes are also much influenced by the moisture in the air. Linen and cotton shrink from dampness and thus are drawn tight; they, however, wrinkle and becomes loose from dryness. Oiled paper, which Blériot has used to considerable extent in his single-deckers, exhibits the same fault. Aluminum and magnalium sheets, which latter was used by Jatho at first, are heavier than textile fabrics and much more expensive. At present there is almost exclusively employed a cotton stuff made by the Continental Rubber and Guttapercha Company, which is made water-tight by absorption of gum.

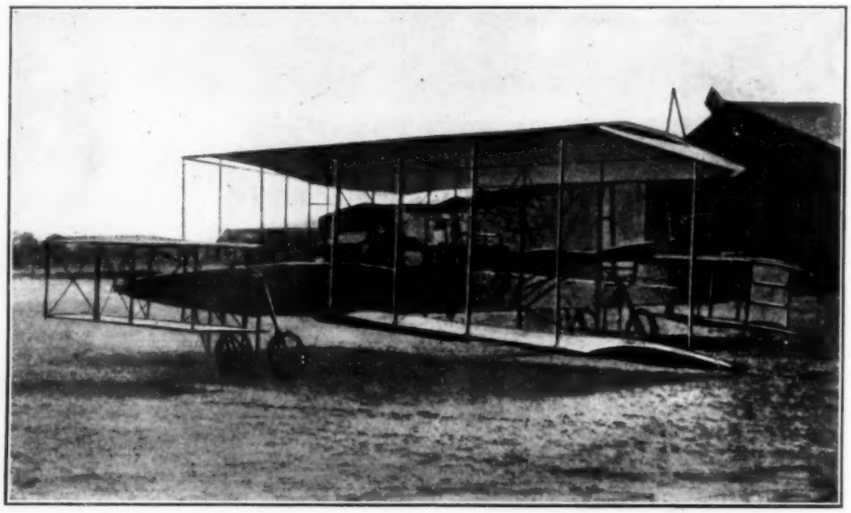


FIG. 52. AËROPLANE OF PIQUEREZ

Levy & Gaillat, in Paris, have built a double-decker which suggests Jatho's flying machine. As in the case of his, the upper supporting plane is considerably narrower than the lower main plane and is revolvable about an axis transverse to the direction of flight. In this manner the upper plane forms the control for elevation. This control is actuated by a hand lever, which is placed on the same shaft with two double-armed levers and acts upon the control planes by two connecting rods. There is no lateral control, but that is effected in a simple manner by revolving the motor with the propeller. For that purpose it is fastened to a ring carrying a gear which engages with a worm turned by a handwheel. The

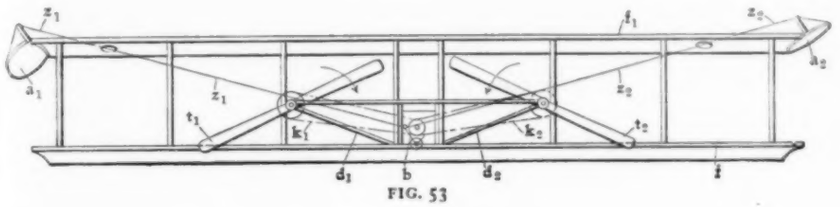


FIG. 53

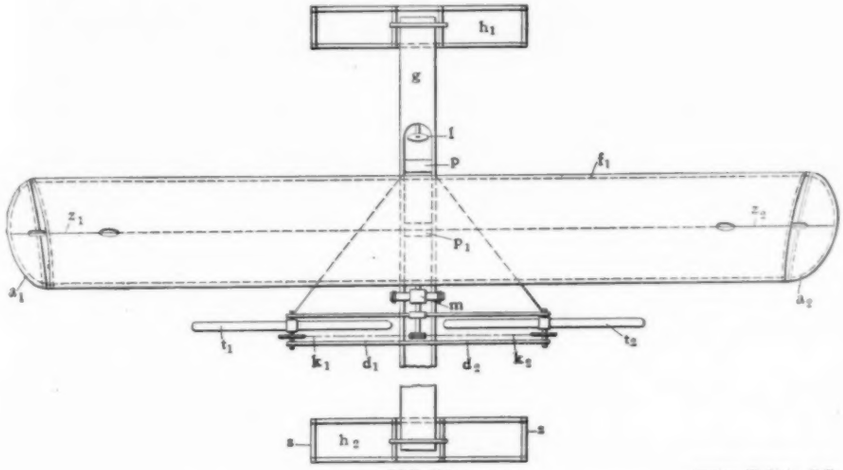


FIG. 54 *American Machinist, N. Y.*

DIAGRAMMATIC VIEWS OF AËROPLANE OF PIQUEREZ

motor, a water-cooled 20-horsepower automobile engine of Dion & Bouton, directly drives the two-bladed propeller. Since there is no tail plane, the stability may be questioned. The inventors believe, like Jatho, that they have secured equilibrium in both directions through the comparatively low center of gravity of their aëroplanes. This, however, can be true only in very quiet air. Noteworthy is the small curvature of the supporting planes; the curvature of the upper planes may be imparted by tension cords.

Monoplane or *biplane* is one of the still unanswered questions. Properly the question should be framed: monoplane or multiplane? since aëroplanes have been attempted with three planes and upward. Beside Jatho, Voisin has built a three-decker for Goupy. The advantage of the double-decker is, that for equal sustaining power it is not so wide. Furthermore, double-deckers have shown themselves steadier in the direction of flight which is attributable to the fact that the air held between the main planes dampens the vibration. The disadvantage of double-deckers is, that the superposed planes have less sustaining power, because the upper ones lie to a certain extent in the "shadow" of the lower. This is especially to be observed in gliding. The greater the vertical distance between the main planes, the smaller this objection becomes. But on the other hand, the weight is thereby increased, because the vertical struts must be longer and stronger. To double-deckers remain, however, advantages of construction which hardly can be said of three-deckers, because their hight is too great if the three planes are held at favorable distances apart. Goupy has, therefore, discarded the third plane, like Jatho, who formerly employed three planes; and subsequently Farman, who had used a third, smaller plane over his two main planes.

In regard to the remaining arrangements this flying machine inclines toward the second double-decker of Blériot, except that the adjustable planes which serve as elevation control and for lateral steadying, are set between the tail planes. Thereby their lateral steadying effect can hardly be increased, because they act upon

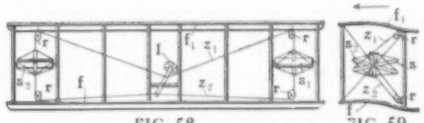


FIG. 58 FIG. 59

American Machinist, N. Y.

AËROPLANE OF CODY

a much shorter lever arm. There is consequently required a comparatively great rotation of this plane, which, however, increases its resistance in the direction of flight. Small planes, slightly displaced, but with long lever arm, work far better.

Grade, in Magdeburg, who hitherto has had the best results of any German aviator, still adheres to three-deckers, Fig. 68. Rudders for control laterally and in elevation are placed at the rear, the propeller at the front analogously to the three-decker of Goupy. The maintenance of lateral stability, however, is obtained as in Wright's machine, by turning of the main planes. The aëroplane of Grade is the only flying machine driven by a two-cycle motor. This engine has here acted very well, and proved highly efficient in relation to weight. Motors on aëroplanes run with almost regular turning moments and rotative speeds; this is a point favorable to the two-cycle motor for aviation, and it has other advantages, such as light weight and conceivably simple construction, which here are qualities far more important of attainment than in the case of motor cars. Revolving motors, air-cooled, as they are now built for flying machines in four-cycle type, with cylinder masses which cool excellently and at the

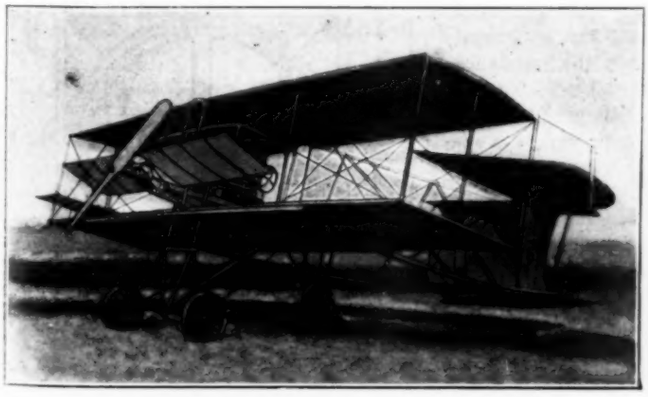


FIG. 55. AËROPLANE OF GUYOT AND JAUGEY

FIG. 56. AËROPLANE OF SCHÜLER

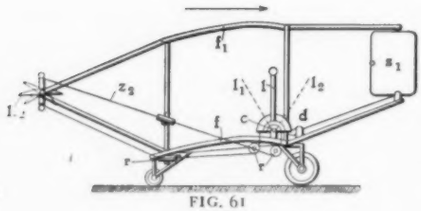


FIG. 61

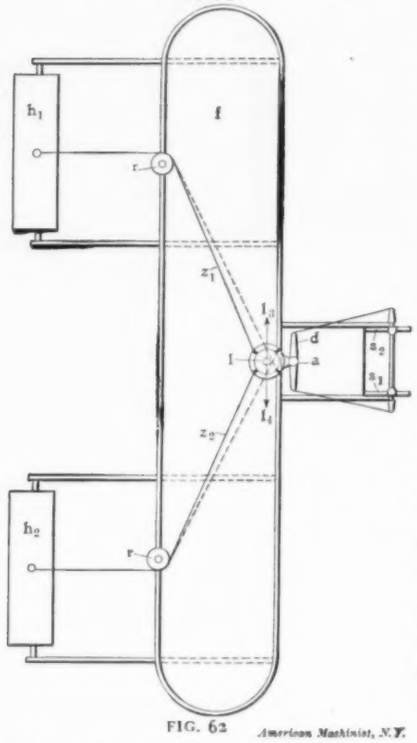


FIG. 62 American Machinist, N.Y.

ARRANGEMENT OF STEERING PLANES OF AËROPLANE OF BLÉRIOT, NO. 11

same time act as a flywheel (Adams, Bucherer, Gnome, Hayn, Schüler), may also be built in the form of two-cycle motors. The latter have also the great advantage that equal regularity of running is attained with four cylinders instead of seven, as in the case of four-cycle engines. An unequal number of cylinders is required in the case of four-cycle motors, when the cylinders are arranged in star form, in order to make the angular distance between each two explosions equal.

To the class of aëroplanes with several planes, belongs also that of the Englishman Phillips. According to a suggestion of Wenham, Phillips has increased the number of superposed supporting planes to 20, Figs. 69 and 70. In consequence, the single planes are very narrow. Beside the fact that this multiplicity of planes is disadvantageous in gliding, it has not yet succeeded in giving stability.

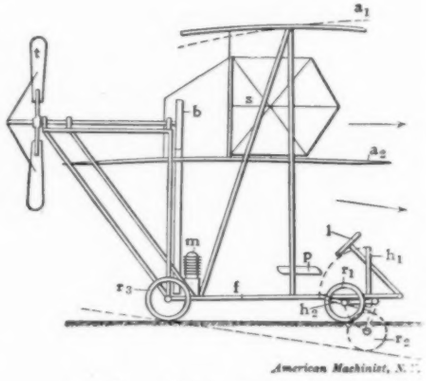
The purpose of this use of many small planes is to save width so that the flying machine is more handy. Such aëroplanes are therefore designed repeatedly, most recently by Maurice Carron, at Paris, who superposed 70 narrow planes. This form of construction does not seem to be well chosen; much more likely would monoplanes be to succeed.

Likewise equipped with many supporting planes, yet radically different from the ordinary type of aëroplanes, is that of Giraudan, at Villefranche. In this, the supporting surfaces consist of two sets of radial planes, arranged in two cylinders. These cylinders have tubular frames covered with textile material. The front system of planes is movable about a transverse axis and can be set by the operator at such angle of incidence as he desires, by means of a long lever. This lever is operated by the foot. A second, much longer, hand lever actuates the motion of the front system of planes around a vertical axis for turning control. Special controlling devices for maintaining lateral stability are not provided. This is accomplished by the resistance of the radial planes to revolution and insured by the position of the center of gravity below the center of resistance. Therefore, the axis, as well as the center of the two systems of planes, lies at the upper edge of the body framework that carries the motor with the propeller and the seat for the operator. The motor has eight cylinders arranged in V form and drives the two-bladed propeller by gearing, with a speed reduction of one-half. The starting frame carries four wheels, of which the front ones may be turned about vertical axes. It is obvious that the supporting planes are not curved; they can, however, bag under pressure of the air. The advantage of this construction as against double-deckers and single-deckers is its narrowness, while on the other hand, we may assume as a disadvantage that the planes have less sustaining power for equal area and apparently the weight is greater. However, this aëroplane is a novel solution, and since the first trials have not turned out badly, its progress may be watched with interest.

Arrangements for Taking Flight

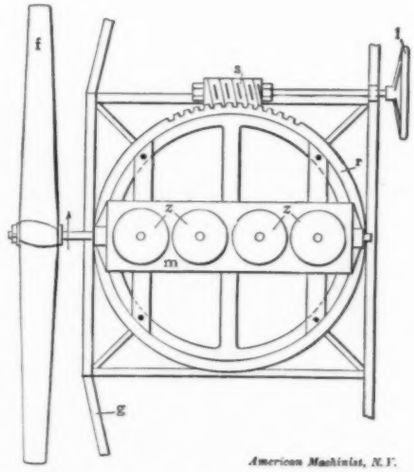
It is well known that aëroplanes require for taking flight a speed greater than that needed for horizontal progress. They must, therefore, make a start on the ground. Even when mounted on wheels, and running upon a very smooth field, they encounter friction, in addition to the resistance of the air, so that the power of the motor for starting must generally be greater than required for horizontal flight. In order to lessen the resistance of starting, various means have been devised. Voisin has so arranged his flying machine that the planes, through the resistance of air and ground, are reduced to a small angle of incidence, as they are after having started. (See Fig. 72). For this purpose the control for elevation must be placed horizontal at the start. Even at a small speed the air pressure on the tail planes is so great that they, being lightly loaded, are elevated. Thus the main plane is reduced to a small angle of incidence, the resistance is correspondingly diminished, and the aëroplane sooner reaches a high speed. When a sufficient velocity for flight is reached, the forward edge of the rudder for elevation is turned upward, the air pressure lifts it, and with it the main plane, the angle of incidence is increased, and the now considerable air pressure on the main plane lifts the entire machine. Consequently, the greater part of the starting distance is covered by the aëroplane resting on its front wheels alone. On a sufficiently large open field, which does not present too great unevenness, this method of starting is very effective. However, a course of at least 325 feet is generally necessary to make an ascent; and to attain sufficient hight for flying over trees and other obstacles an open space of at least 650 feet more is necessary. The need of a large free place is therefore an objection to this method, which on the other hand, has the great advantage of dispensing with special appliances separate from the flying machine.

According to the same principle, Jatho starts his aëroplane, Fig. 64. By means of the frame of the front wheels, the flying machine can be elevated or lowered in front. For this purpose the front wheels are fastened to a jointed fork; if at the start they are set horizontally, the aëroplane inclines forward, and the main planes stand approximately parallel with the ground. The resistance is thus



American Machinist, N.Y.

FIG. 64. AËROPLANE OF JATHO



American Machinist, N.Y.

FIG. 66. MOTOR OF AËROPLANE OF LEVY AND GALLAT

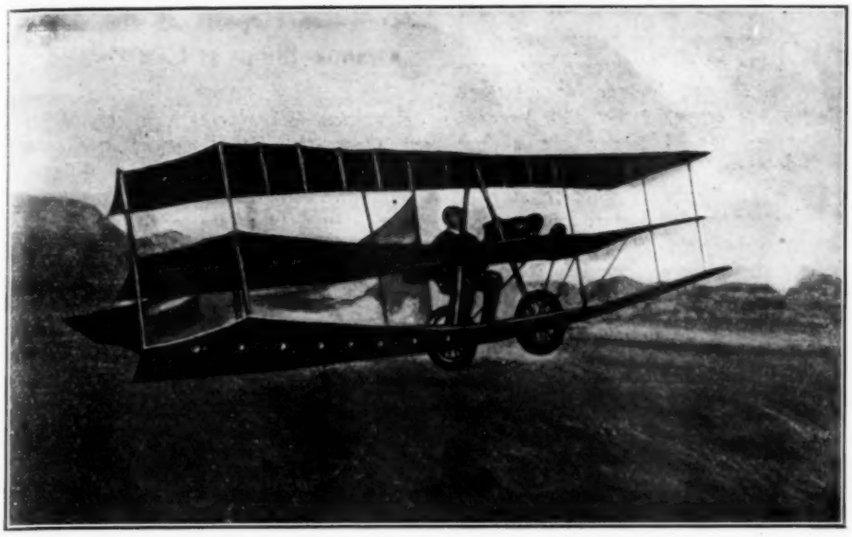


FIG. 68. AËROPLANE OF GRADE IN FLIGHT

slight, and the machine soon reaches the required speed. If then the fork is placed vertically, the main planes are raised in front, assuming the required angle of incidence, and the pressure of the air on the planes raises the aëroplane. The advantage of this over the method of Voisin is therefore, that the main planes may be set so as to encounter less resistance from the start, whereas in Voisin's they assume such a position by the air pressure after a short run. This advantage may, however, be attained by Voisin if he makes the support of the hind wheels longer, or so hinges it that the tail planes may be placed higher before the start, the main and tail planes thus becoming nearly parallel with the ground.

Departing from this construction, Wright starts his aëroplane by using an appliance not attached to the machine, but left on the ground when it ascends. By applying additional power, he quickly brings his airship to the speed required for taking flight, using for this purpose a drop weight. If the auxiliary impulse be strong, the starting course is very short. By use of a starting rail, the friction on the path is greatly lessened. The starting wheels are consequently very simple, mere wooden rollers, while Voisin and others, whose aëroplanes run on the ground, have to use wheels with pneumatic tires. In order to decrease the weight of the flying machine, Wright leaves his starting truck behind him on the ground. With the wheels thus removed, landing is safer and the stopping distance much shorter, since the skids offer far more resistance to the ground. The elastic skids also take up the shock of landing very well without being subject to the same danger of injury as wheels with their movable forks. With a sufficiently powerful motor, Wright can naturally start without any auxiliary power, and, therefore, without a drop weight; for he can do so if the starting path is inclined, or if there is a sufficiently strong wind against the flying direction. In fact, Wilbur Wright has several times ascended in a head wind without employment of a drop weight. In doing so he uses a much smaller open space than Voisin; moreover, the place need not be so level since the smaller irregularities of the ground are covered by the starting rail. A disadvantage of Wright's starting is, that the flying machine is dependent upon an appliance for the purpose if there be not a suitable open place for flying off against the wind. On the other hand, these appliances can be made very crudely; for instance, the frame of the drop weight can be quickly built from a few trees. Cords are easily come by, and the pulleys can be carried in the machine itself. In war, starting appliances can be conveyed by automobiles.

As a drop weight, may be employed the flying machine itself. An example is the first aëroplane of Counselor Hoffman, of Berlin, with which, by tipping over of stilts that supported the flying machine, the air under the main planes was compressed. The ascent, therefore, took place after the fashion of storks and other long-legged birds. The defect in that arrangement was, that before the flight the flying machine was easily turned around by the wind. Fig. 74 shows a device of my own suggestion by which this defect is remedied. With the aid of a support, which can be simply made of two trees, the aëroplane is easily raised up by a tackle or windlass. As soon as the propeller is set in motion, the flying machine, which is firmly held up by the rope, must assume the angle of incidence. If now the machine is set free from the rope by a detachable hook, it will at first drop somewhat, whereby the air under the main planes will be condensed and simultaneously the propeller will drive forward the machine; which then, if the rudder for altitude be properly turned, will describe the intended path through the air, as indicated by a dotted line in the figure. The advantages of this method of starting seem to be, the very simple appliances and its demand for only a very small open place, where the ground need not be level.

The results of my discussion of aëroplanes in general, and double-deckers in particular, may be summed up as follows:

1. The double-decker, as compared with the single-decker, is steadier in flight and, for an equal supporting power, may be built narrower. The framework of the main planes can be better stiffened. The objections are: Greater weight for equal sustaining power, greater resistance, and therefore a more powerful motor necessary for equal speed, from which results a smaller radius of action with the same amount of fuel and therefore a somewhat higher cost of operation.

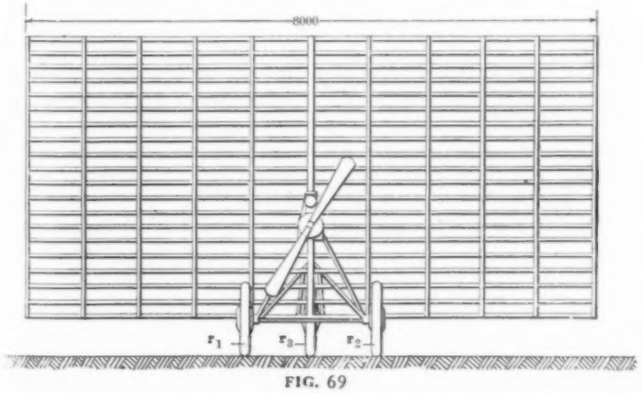


FIG. 69

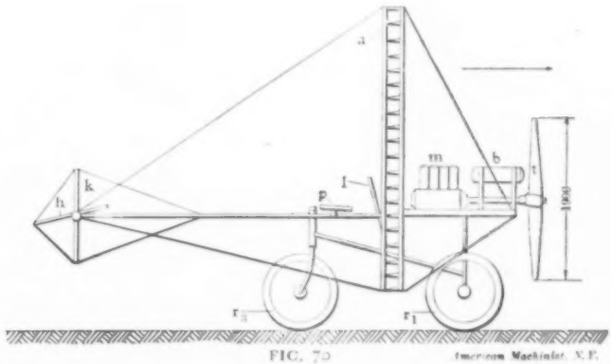


FIG. 70

AËROPLANE OF PHILLIPS

2. Automatic stabilizing is unreliable in gusts of wind, specifically side winds. Maintenance of lateral equilibrium is very important, and the best method for that purpose is warping the main planes; pivoted planes are not so good. The warping need be done only on one side, viz., the side lying in the curve since otherwise the turning control must be operated at the same time. It is advantageous that both the main planes and rudder for elevation be warped.

3. It is best to place the rudders for elevation and turning behind the main planes, the turning rudder in an imaginary transverse axis with the propeller screw and the center of gravity, which will put the control for elevation at such distance from the main planes that its center of gravity will lie in front of the rear edge of the main planes.

4. In order to prevent a one-sided action, two contrary running propellers should be chosen. In order that if a propeller breaks the aëroplane shall not tip, the two screws must have the same axis. Since then the rear screw is subjected to the air current from the front least, like Wright, to disconnect the motor by holding open an escape valve, so that when the motor is thrown out, compression shall not impede the further turning of the propeller, for such increase of resistance would hinder the gliding flight, and considerably abbreviate it.

8. On level ground of sufficient extent, is to be recommended a start by means of a run, or otherwise by a drop, and the aëroplane should be equipped for both.

9. Hitherto two forms of construction for double-deckers have been developed, the Wright and Farman-Voisin. Almost all other practically flying double-deckers are more or less patterned after them. Thus far the Wright form is the best.

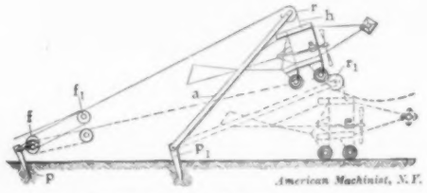


FIG. 74. START OF AN AËROPLANE BY MEANS OF A FREE FALL

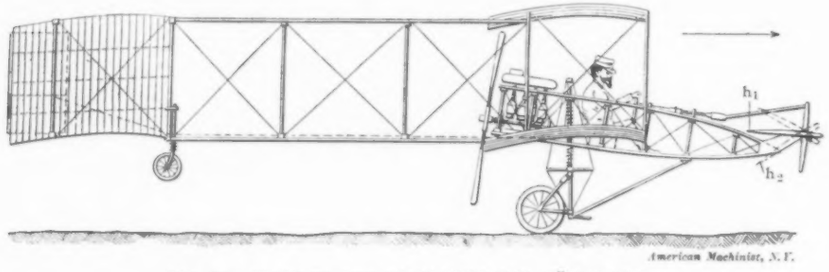


FIG. 72. START OF THE FARMAN-VOISIN AËROPLANE

one, such an adjustment must be made that the effect of the two screws shall be equal; either differential gearing being employed, or, in case of a revolving motor, the one screw being driven by means of a crankshaft and the other (the front one) by the housing which revolves with the cylinders.

5. Air-cooled motors are to be recommended for aëroplanes only in the lower powers, or if constructed with revolving cylinders, since otherwise the cylinder cooling is insufficient. Motors with revolving cylinders have the further advantage that the heavy cylinder masses equalize the motion and produce a greater gyroscopic effect, which automatically assists the maintenance of stability (of lateral stability only if the motor shaft be vertical). There seems to be a great outlook for two-cycle motors in flying machines.

6. All steering movements must be made by means of *one* element (lever or wheel) manipulated in the manner customary for other vehicles. Appropriate forms of construction are those of Blériot, Voisin, Kober and Vorreiter.

7. It is preferable to introduce a coupling between motor and propeller, or at

10. High speed of flying should be striven for, so as to get along with smaller planes.

11. As materials of construction are recommended wood for the frame and gummed cotton fabric for the supporting and controlling planes.

Industrial Accidents

A public hearing by the commission appointed by Governor Hughes, of New York, on Employers' Liability and Causes of Industrial Accidents, Unemployment and Lack of Farm Labor, was held in the City Hall, New York, on Nov. 11. This is one of the many indications of the interest being taken in the question of industrial accidents and their prevention in various parts of the country. Further hearings are to be held from time to time in New York, Albany, Buffalo, Rochester and Syracuse, as the Commission desires to give everyone interested an opportunity to present his or her views and advice on any of the subjects mentioned. They will also receive suggestions in writing if it is inconvenient or undesirable to submit them orally at these hearings.

Locomotive Repairs at the Lackawanna Shops at East Buffalo

Repairing locomotives is a very different proposition from almost any other work I know of, and requires different treatment. Micrometers are an unknown quantity in most of the work, yet the results are probably as good as can be expected when the service is considered. Side rods must have play on the pins, both as to diameter and end movement, varying from 1/64 to 1/32 inch, because the different crank pins are almost never in line on account of frogs, switches and high and low spots in the track. But the main rod

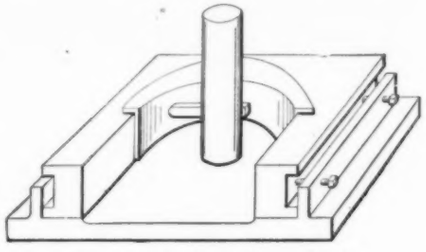


FIG. 1. BORING DRIVING BOXES

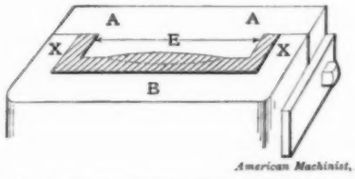


FIG. 2. A SIMPLE CROSSHEAD BABBITTING JIG

has to be as close as it will run cool on account of pounding out the brass, to say nothing of the noise.

Rebolting a Frame

When an engine comes in for general repairs and the frame bolts have to be driven out, it's a case of new bolts when the engine is put together again. These bolts have a taper body and drive into the reamed taper holes of the frame. The taper is usually 1/16 inch to the front.

This is usually a case of fitting each bolt to its place, as the holes are just cleaned up with the reamer in the air drill. This fitting has to be well done as it is very important that they should not work loose.

To do this rapidly, the foreman in charge of this work at the East Buffalo shops of the Delaware, Lackawanna & Western road has a portable outfit which he sets down near the track the engine is on. This outfit consists of a lathe, a centering machine and a grinding wheel for sharpening tools, all tied together on one base and driven by an independent motor.

A bright boy completes the outfit and the combination gives star performances when it comes to fitting up a locomotive frame with new bolts. The bolts are centered and the ends all threaded to standard size before the frame has been reamed,

and as soon as a few holes are ready the boy gets busy.

He sets a pair of inside calipers to both ends of the first hole to be sure and get the right taper set in the lathe, then he starts in, only measuring one end of the rest of the holes, and turns each bolt to fit its hole. There is no micrometer about it; he just sets his outside calipers by the inside calipers set to the hole, measures by "feel" in the old-fashioned way, and does a good job in a lathe that had seen hard service long before it joined the bolt-turning outfit.

Detecting Cracks in Frames, Rods and Axles

Every railroad shop has its hair-raising story of axles that have dropped in two on the turntable after a hard run and other cases, all depriving the yellow journals from a prominent display of scare headlines about another wreck, and the best or worst of it is they are true. In no place is the effect of constant vibration better shown than in railroad service, the most prominent defects occurring in frames, rods and axles, all of which are hard to detect unless they are very pronounced. The hammer test helps in many cases where the man is trained for the work, but even this is not infallible.

The master mechanic at these shops, B. H. Hawkins, has introduced a method that is at once simple and efficient whether it is original or not. When an engine comes in for repairs and is stripped, the frames, axles and rods are given a coat of a white water paint. This dries in about an hour and does not rub off readily.

Then, as the wheels are turned up in the lathe, or the frames and rods worked on in any way, or even without it, the oil and dirt that are in any crack in these parts work through this paint and show a dark streak so plainly that it cannot be mistaken. At the time of my visit a driving axle had just been discarded owing to a slight crack just starting from the round corner of a keyway for the eccentric, and which would never have been discovered in any other way.

The same thing holds good in the other parts, and cracks are constantly discovered that might cause accidents later had they not been found. So a little white paint is probably a life saver when applied in this way.

Boring and Facing Driving Boxes

Two Bullard vertical lathes or boring mills with a side tool carriage or head, are in use here doing all sorts of face-plate work. The way in which driving boxes are bored is interesting as showing the use to which the side head is put as well as the method of holding and boring.

The lower plate or fixture is bolted to the faceplate, and the driving boxes fit in this and are easily centered and set. A hole in the center of this plate forms a guide for the pilot on the boring bar, as shown in Fig. 1, holding it steady in its work and insuring a straight cut as well as making high speed possible.

At the same time the side head comes in and faces off the hub lining so that no extra time is required for this work. It makes a neat way of handling work of this kind.

Babbitting Crossheads

They have the simplest form of babbitting jigs, as shown in Fig. 2, I have seen and they do the work in good shape. They depend on the faces *X X* of the crossheads *C*, being planed alike in all cases so far as the distance from one guide to the other is concerned, as well as being the same width on the outside. This allows the fixtures or jigs to be held on the crossheads by the simple clamps, shown at the side, and the babbitt fills the opening between the two, being retained at the bottom by an asbestos sheet or pad on which it rests. The crossheads are tinned beforehand, being heated by an oil torch for this purpose.

There are several sets of these jigs of different widths at *C* to allow for guides being planed down on the sides to true them up at different times. These cost very little to make and have been handling all the babbitting done here for some time.

F. H. C.

Don't Sell Toy Machine Tools to a Trade School

By E. H. Fish*

If it is a possible thing to impress on your advertisers that there is a distinction between trade schools and manual-training schools, it is worth doing. For upward of a year I have been spending some little time looking up possible combinations of equipment for trade schools, both for the old Massachusetts Commission on Industrial Education and for our local school. The thing of all things that has impressed me has been the curious attitude which by far the majority of manufacturers take toward educational institutions. The larger part of my inquiries for prices have resulted in replies about as follows:

"Answering yours of the —th we wish to say that we have equipped most of the manual-training schools in the country complete with our goods and the rest of them have bought largely from us. Therefore you will see that you cannot afford to do otherwise than to order of us. On receipt of your complete list of equipment we will give you the very best figures possible. We inclose a list of the schools using our tools from which you will see that you will be largely criticized if you do not include our tools in your list." This is not in the least exaggerated.

Now, let me ask your readers candidly, Is the fact that a lathe, for example, has been sold to a manual-training school any reason why you would buy it for your own shop? Of course, you would hold up your hands in holy horror at the thought. You would not do that under any circumstances. Then why try to foist them off on a "trade" school? Do you want to demonstrate that a public trade school is impossible by equipping them in such a way that they cannot succeed? It is well known that the advance of manual training has carried with it the design of a large number of small machines designed to give a boy a chance or an excuse for what Sambo would call, "Making a noise like work."

We all know that all the boys can do is to make the motions. The little spindling machines could not possibly stand up under real work. It is not possible to teach a trade by merely making motions. I do not believe that a boy who has built little models of staircases can go out and build real staircases without learning all over; nor do I believe that I would trust a boy with a 6-inch press fit who had never made one over an inch.

These manufacturers not only have the office boy turn out such letters by the hundred and build such near-machinery, but they have trained men that they send out to get the school trade. These men never heard that their firms ever sold machinery to shops. All they can talk about is schools. One was in the other day. He talked schools until I was sick. I told him that we were going to have a shop, no "machine laboratories," or "pattern laboratories," but SHOP, and we wanted shop tools. He gasped, said he thought they did build some, but did not know where they were running. I happened to be well enough acquainted with his employer to know that he did not sell one-tenth part of his output to schools.

This would be a matter for levity if it were not for one thing. There are schools getting ready to spring into life all about us. Whether they succeed or fail as a body depends on what they do as individuals. One school alone cannot succeed except by a miracle. If these schools equip with toy machinery and make models of what they think is made in the shops, they are doomed. It is to the interest of every manufacturer that they succeed. They stand a much better chance of succeeding if the manufacturers will decline to sell them anything that they would not use as a regular thing in their own shop. Some of these trade schools are being handled by men whose acquaintance with machine tools is purely platonic. Don't fill them up with little rickety stuff just for immediate profit. Help them to choose wisely. It will pay in the end.

*Manager, Worcester School of Trades.

Some Strength Tests of Cast Iron*

Tensile Strength, as Cast, and after Machining 1-8 in. Deep, also with Increasing Percentages of Silicon. Transverse, Deflection and Resistance Tests

BY E. ADAMSON

The very great variations in the tests which have been obtained from cast iron from time to time, and the differences of opinion which exist as to the best methods of testing, determined the author to make the comparative tests which form the subject matter of this paper.

These tests were all carried out in actual foundry practice, the metal used being taken chiefly from the ordinary cylinder mixtures, which remained over and above what was required for the tests used in the ordinary shop work. The object of the tests was in no way to secure the highest possible results, but, if possible, to arrive at the differences in results under varying working conditions.

The author wishes to state his appreciation of the work of T. Turner, W. R. Johnson, West, Keep and Outerbridge, on cast iron. Their results are all of much value in the intricate problems involved in the study of that material.

Tensile Tests

Nine boxes were used for casting the twenty-four tensile-test bars and six transverse-test bars from the one ladle. The tensile bars numbered 1 to 3 were cast to a diameter of 7/8 inch; Nos. 4 to 6 to a diameter of 3/4 inch; Nos. 7 to 9 to a diameter of 5/8 inch, and Nos. 10 to 12 to a diameter of 1/2 inch. The tensile bars from 13 to 24 inclusive were cast 1 inch diameter, and were machined down to the same diameter as Nos. 1 to 12, and the six transverse-test bars were then cast on edge at an angle of 22½ degrees.

In Table 1 are shown the results of the tests obtained, which appear to indicate that the bars that have been machined give better results than those that have been tested, as cast, with the skin on. The results of the transverse and deflection tests are given later.

Twelve tensile-test bars and four transverse-test bars were cast from the same ladle, duplicating tests Nos. 13 to 24, in order to confirm if there were any special diameter of the turned bars which gave the highest results, but from the second part of Table 1 it would appear that the bars turned down to 3/4 inch to 1/2 inch show very little variation in the test per square inch.

Five sets of bars—three tensiles and two transverse bars, each with the same percentage of silicon (the latter cast on edge at an angle of 22½ degrees)—were cast from the same ladle of metal as those entered in Table 1, but varying percentages of 50 per cent. ferrosilicon were added to each small ladle (taken from the larger ladle), in order to increase the percentages of silicon in the test bars. This was duplicated.

Numbers.		Analysis.							Diameter of Test-bars.		Tensiles.	
Skin on as Cast.	Turned.	T. C.	G. C.	C. C.	Si.	S.	P.	Mn.	As Cast.	Turned.	Average of Each Diameter.	Mean Over All Areas.
		Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Inch.	Inch.	Tons per Sq.In.	Tons per Sq.In.
1–3	..	3.56	2.98	0.58	1.53	0.11	1.19	0.90	7/8	..	12.32	..†
4–6	..	"	"	"	"	"	"	"	3/4	..	12.76	..†
7–9	..	"	"	"	"	"	"	"	5/8	..	12.11	..†
10–12	..	"	"	"	"	"	"	"	1/2	..	13.69	12.72†
..	13–15	"	"	"	"	"	"	"	..	1/2	Flaws.	*†
..	16–18	"	"	"	"	"	"	"	..	1/2	13.20	..†
..	19–21	"	"	"	"	"	"	"	..	1/2	14.72	..†
..	22–24	"	"	"	"	"	"	"	..	1/2	13.96	13.96†
Duplicating Tests 13 to 24.												
..	40–42	3.54	2.96	0.58	1.30	0.077	0.59	0.68	..	1/2	13.69	..†
..	43–45	"	"	"	"	"	"	"	..	1/2	15.62	..†
..	46–48	"	"	"	"	"	"	"	..	1/2	15.59	..†
..	49–51	"	"	"	"	"	"	"	..	1/2	15.38	15.07†

*Flaws in all bars. †From one ladle.

TABLE 1. TENSILE TESTS. VARYING DIAMETERS AS CAST AND TURNED.

Effect of Silicon on Strength

In Table 2 is shown the results of these tests, which were made with the idea of ascertaining the value of the use of high percentages of ferrosilicon in actual foundry practice. A number of the tensile tests showed flaws, and as the tests obtained therefrom were in consequence very low, they have not been included, as the true area of the bar could not be obtained. The sound bars were all tested, and the average results taken as the mean of each set of bars.

In Table 1 the percentages of silicon that were actually added to the metal are shown, together with the increasing percentages of silicon, and it is noticeable that in spite of the silicon being increased from 1.53 to 2 per cent. in the one case, and in the other from 1.30 to 1.86, the combined carbon shows practically no alteration.

Further, as the other elements are practically constant, it may be assumed that Table 2 shows the effect of increasing silicon, and while the first part of the table presents practically no difference in the average results from bars with from 1.67 to 2 per cent. of silicon, the second part shows a decrease in the strength as the silicon increases.

This, therefore, does not confirm the results contained in the first part of the table, obtained with bars of varying silicon content, and would point to some condition of the iron, apart from the analyses, which has a greater effect on the results of the tests.

Also from the fact that the percentage of combined carbon has not been reduced in spite of the addition of one-third more silicon, it would further show that silicon alone is not the only factor in the conversion of combined carbon to graphite. One point is very clear, namely, that with the increase of silicon the crystals of the iron have also increased in size; but these are also affected by the cooling conditions which are independent of the analysis.

Transverse Bending Tests

In Table 3 are given the transverse tests, and in this case also it will be noticed that while the breaking weight of the transverse-test bars shows a slight variation, when the latter are worked out on the exact section of the bar to the moment of resistance, there is very little variation in the tests obtained from those bars with increased percentages of silicon, while the second part of the table shows that increasing amounts of silicon have decreased the strength, which confirms the tensile tests in this respect.

In this case, also while the percentages of combined carbon are not very materially altered, the fractures in the 2x1-inch test bars show increasing openness as the silicon increases from 1.30 to 2 per cent.; the bars with the higher percentage showing the most open fracture.

By Table 4 is shown the difference in tests obtained from the transverse-test bars as cast and as machined, indicating a great improvement in the strength of the machined bar. It has generally been

*Paper delivered before the Iron and Steel Institute.

Mark.	Analysis. T. C.	G. C.	C. C.	Si.	S.	P.	Mn.	Actual Silicon Added.	Diameter of Test-bar at Fracture.	Tensile Strength per Square Inch.	Mean of Sound Bars
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Inch.	Tons.	
16	3.56	2.98	0.58	1.53	0.11	1.19	0.90	None	¾	Machined from 1 inch, 14.03	..
17	"	"	"	"	"	"	"	"	"	" " " 13.48*	..
18	"	"	"	"	"	"	"	"	"	" " " ..	13.75
28	3.57	3.04	0.53	1.67	0.106	1.20	0.85	0.14	"	" " " 14.72	..
29	"	"	"	"	"	"	"	"	"	" " " 15.31	..
30	"	"	"	"	"	"	"	"	"	" " " 14.59	14.88
31	3.56	3.00	0.56	1.65	0.075	1.20	0.87	0.12	"	" " " 15.38	..
32	"	"	"	"	"	"	"	"	"	" " " ..†	..
33	"	"	"	"	"	"	"	"	"	" " " 15.48	15.44
34	3.58	2.99	0.59	1.88	0.106	1.17	0.80	0.33	"	" " " 15.22	..
35	"	"	"	"	"	"	"	"	"	" " " 14.54	..
36	"	"	"	"	"	"	"	"	"	" " " ..†	14.88
37	3.57	2.98	0.57	2.00	0.09	1.17	0.81	0.47	"	" " " ..†	..
38	"	"	"	"	"	"	"	"	"	" " " ..	..
39	"	"	"	"	"	"	"	"	"	" " " 15.47	15.47
43	3.56	2.98	0.58	1.30	0.077	0.59	0.68	None	"	" " " 15.67	..
44	"	"	"	"	"	"	"	"	"	" " " 15.58	..
45	"	"	"	"	"	"	"	"	"	" " " 14.74†	15.62
52	3.59	3.05	0.54	1.46	0.073	0.84	0.65	0.16	"	" " " 14.28	..
53	"	"	"	"	"	"	"	"	"	" " " 14.42	..
54	"	"	"	"	"	"	"	"	"	" " " 15.03	14.57
55	3.56	3.02	0.54	1.72	0.072	0.78	0.66	0.42	"	" " " 14.94	..
56	"	"	"	"	"	"	"	"	"	" " " 14.94	..
57	"	"	"	"	"	"	"	"	"	" " " 14.04	14.64
58	3.56	3.00	0.58	1.86	0.076	0.70	0.65	0.56	"	" " " 13.97	..
59	"	"	"	"	"	"	"	"	"	" " " 13.78	..
60	"	"	"	"	"	"	"	"	"	" " " 13.47	13.74

*Slight flaws. †Flaw.

TABLE 2. TENSILES WITH INCREASING SILICONS.

Mark.	Analysis. T. C.	G. C.	C. C.	Si.	S.	P.	Mn.	Actual Percentage of Silicon Added.	Size of Test-bar at Fracture.		Transverse, 3 Ft. 0 In. Centres. Cwt.	Mean Cwt.	Deflection. Inches.	Mean Inches.	Moment of Resistance. $f =$	Mean.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.		Inches.							
H	3.56	2.98	0.58	1.53	0.110	1.19	0.90	None	2.05 × 1.050	As cast	34	..	0.344	..	20.804	..
H	"	"	"	"	"	"	"	"	2.09 × 1.040	"	35	..	0.344	..	20.802	..
F	"	"	"	"	"	"	"	"	2.075 × 1.100	"	35	..	0.344	..	19.953	..
F	"	"	"	"	"	"	"	"	2.095 × 1.100	"	35	34.75	0.312	0.336	19.573	20.283
A	3.56	3.03	0.53	1.65	0.098	1.19	0.85	0.12	2.15 × 1.115	"	39	..	0.487	..	20.430	..
A	"	"	"	"	"	"	"	"	2.11 × 1.138	"	38	38.5	0.375	0.386	20.430	20.430
B	3.57	3.04	0.53	1.67	0.106	1.20	0.85	0.14	2.08 × 1.098	"	37	..	0.344	..	20.833	..
B	"	"	"	"	"	"	"	"	2.14 × 1.140	"	36	36.5	0.314	0.329	18.618	19.725
C	3.56	3.00	0.56	1.65	0.075	1.20	0.87	0.12	2.11 × 1.082	"	34	..	0.314	..	19.056	..
C	"	"	"	"	"	"	"	"	2.092 × 1.112	"	36	35.0	0.344	0.329	19.990	19.523
D	3.58	2.99	0.59	1.88	0.10	1.17	0.80	0.33	2.095 × 1.072	"	35	..	0.329	..	20.084	..
D	"	"	"	"	"	"	"	"	2.092 × 1.090	"	38	36.5	0.390	0.359	21.509	20.796
E	3.57	2.98	0.57	2.00	0.09	1.17	0.81	0.47	2.086 × 1.050	"	30	30.0	0.314	0.314	..	17.078
M	3.56	2.98	0.58	1.30	0.077	0.59	0.68	None	2.0727 × 1.048	"	32	..	0.329	..	19.188	..
O	"	"	"	"	"	"	"	"	2.043 × 1.052	"	31	31.5	0.329	0.329	19.062	19.125
I	3.59	3.05	0.54	1.46	0.073	0.84	0.65	0.16	2.057 × 1.030	"	28	..	0.281	..	17.346	..
I	"	"	"	"	"	"	"	"	2.071 × 1.026	"	29	28.5	0.314	0.347	17.793	17.569
J	3.56	3.02	0.54	1.72	0.072	0.78	0.66	0.42	2.079 × 1.036	"	30	..	0.344	..	18.089	..
J	"	"	"	"	"	"	"	"	2.084 × 1.028	"	29	29.5	0.359	0.350	17.537	17.813
K	3.56	3.00	0.58	1.86	0.072	0.70	0.65	0.56	2.087 × 1.024	"	27	..	0.314	..	16.344	..
K	"	"	"	"	"	"	"	"	2.088 × 1.030	"	28	27.5	0.329	0.321	16.833	16.588

TABLE 3. TRANSVERSE TESTS WITH INCREASING SILICONS.

Distinctive Mark. As Cast.	Machined.	Analysis. T. C.	G. C.	C. C.	Si.	S.	P.	Mn.	Size of Bar at Fracture. 3 Ft. 0 In. Centers.	Tested.	Transverse. Cwt.	Mean Cwt.	Deflection. Inches.	Mean Inches.	Moment of Resistance per Square Inch. f Tons.	Mean Tons.
		Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.								
F		3.56	2.98	0.58	1.53	0.110	1.19	0.90	2.05 × 1.05	As cast	34	..	0.344	..	20.804	..
F		"	"	"	"	"	"	"	2.09 × 1.04	"	35	34.5	0.344	0.344	20.802	20.803
	G	"	"	"	"	"	"	"	2 × 1	Machined	34	..	0.437	..	22.950	..
	G	"	"	"	"	"	"	"	2 × 1	"	33	33.5	0.437	0.437	22.275	22.612
H		"	"	"	"	"	"	"	2.075 × 1.10	As cast	35	..	0.344	..	19.953	..
H		"	"	"	"	"	"	"	2.095 × 1.10	"	35	35.0	0.312	0.327	19.573	19.763
M		3.54	2.98	0.56	1.30	0.077	0.59	0.68	2.0727 × 1.048	As cast	32	..	0.327	..	19.188	..
O		"	"	"	"	"	"	"	1.052 × 2.043	"	31	31.5	0.327	0.327	19.062	19.125
	L	"	"	"	"	"	"	"	1.868 × 0.873	Machined	24	..	0.375	..	21.273	..
	N	"	"	"	"	"	"	"	1.8685 × 0.880	"	26	25.0	0.468	0.421	22.862	22.067
G		3.71	3.05	0.64	1.34	0.09	1.12	0.60	2.043 × 1.082	As cast	35	..	0.352	..	20.09	..
G		"	"	"	"	"	"	"	2.081 × 1.072	"	34	..	0.305	..	19.8	..
G		"	"	"	"	"	"	"	2.078 × 1.080	"	33	34.0	0.328	0.328	19.1	19.9
	G	"	"	"	"	"	"	"	2 × 1	Machined	..	34.0	..	0.461	..	22.9

TABLE 4. COMPARATIVE TRANSVERSE TESTS AS CAST AND AS MACHINED.

assumed that the skin of the test bar increases the strength, but this investigation has proved quite the contrary, and results in actual practice since these tests were made have confirmed the results.

While making these tests, also, it was thought desirable to see what position of the transverse-test bar gave the best results. The bars in each molding box were cast in a different position, namely: *F* was cast flat with no inclination; *G* cast on edge with no inclination, and *H* cast on edge with an inclination of 3 inches in 3 feet.

The results are given in Table 5, and do not show that there is any material difference in the bars cast on edge. It was shown by the author in May, 1906, in his paper read before the Institute, that the transverse-test bar tested with the "fin" up—that is, the "fin" in compression and the lower part or sounder part in extension—invariably gave the best results.*

		Metal from One Ladle.							Transverse 2′ × 1′ × 3′0″ Centers.		Deflection.		Moment of Resistance.	
		T. C.	G. C.	C. C.	Si.	S.	P.	Mn.	Cwt.	Mean Cwt.	Inches.	Mean Inches.	Tons.	Mean Tons.
		Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.						
F	*a*	3.71	3.05	0.66	1.34	0.09	1.12	0.60	35	..	0.344	..	21.1	..*
	b	..	..	..	..	..	..	..	28	..	0.258	..	17.0	..*
	c	..	..	..	..	..	..	..	28	30.33	0.266	0.289	18.5	18.9*
	d	..	..	..	..	..	..	..	..	..	..	..	..	..†
G	*a*	..	..	0.64	..	..	..	..	35	..	0.352	..	20.9	..‡
	b	..	..	..	..	..	..	..	34	..	0.302	..	19.8	..‡
	c	..	..	..	..	..	..	..	33	34.0	0.328	0.327	19.1	19.9‡
	d	..	..	..	..	..	..	..	..	34.0	..	0.461	..	22.9§
H	*a*	..	..	0.63	..	..	..	..	34	..	0.312	..	19.9	..‖
	b	..	..	..	..	..	..	..	31	..	0.336	..	19.5	..‖
	c	..	..	..	..	..	..	..	30	31.66	0.297	0.315	19.2	19.5‖
	d	..	..	..	..	..	..	..	..	..	..	..	..	..

*Tested as cast. Cast flat, with no inclination. †Machined bar, unsound. Cast flat, with no inclination. ‡Tested as cast. Cast on edge, with no inclination. §Machined bar. Cast on edge, with no inclination. ‖Tested as cast. Cast on edge, with an inclination of 3 inches in 3 feet 0 inch.

TABLE 5. TRANSVERSE TESTS FROM SAME LADLE UNDER DIFFERENT CONDITIONS OF CASTING.

Casting Temperature

There has been a good deal of discussion upon the temperature at which cast iron should be poured into the mold, a medium casting temperature being considered by some to give the best results. To prove this, 10 hundredweight of iron was taken from the cupola and poured into five sets of molds. The first mold was poured at 3:40 p.m., well within two minutes of being tapped from the cupola, the second at 3:45 p.m., the third at 3:50 p.m., the fourth at 3:55 p.m., and the fifth at 4 p.m., showing a five minutes' interval between each mold. The tests shown in Table 6 clearly indicate that the mold poured first gave the best results.

Moment of Resistance Test

It will be noticed that the transverse tests are all worked out to the moment of resistance in order to see what the results of a given test would be on the exact section of the transverse bar. In Table 2 it will be seen that each bar is slightly over the 2x1-inch dimension, and the area therefore of each test bar varies, as do also the tests, but when worked out to the moment of resistance based upon Unwin's formula:

W = Breaking weight in tons,
L = Length of the bar between supports in inches,
b = Breadth of bar in inches,

**Journal of the Iron and Steel Institute*, 1906, No. 1, p. 91 (Table A).

Tensile Mark.	Transverse Mark.	One Ladle of Iron Cast at Different Temperatures.							Time of Casting.	Tensiles.		Transverse.		Deflection.		Moment of Resistance.	
		T. C.	G. C.	C. C.	Si.	S.	P.	Mn.		Tons.	Mean Tons.	Cwt.	Mean Cwt.	Inches.	Mean Inches.	Tons.	Mean Tons.
		Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	P. M.								
50		3.76	3.10	0.66	1.30	0.114	1.14	0.54	3.40	16.19	..	..	..	..	..	..	..*
51		..	..	..	..	..	..	..	..	16.13	..	..	..	..	..	..	..*
52		..	..	..	..	..	..	..	..	16.4	..	..	..	..	..	..	..*
53		..	..	..	..	..	..	..	..	16.32	16.21	..	..	..	..	..	..*
	A	..	..	0.66	..	..	..	..	..	..	..	32	..	0.375	..	20.3	..*
	A	..	..	..	..	..	..	..	..	..	..	33	..	0.3125	..	20.3	..*
	A	..	..	..	..	..	..	..	..	..	..	33	32.66	0.344	0.343	20.6	20.4*
54		..	..	0.66	..	..	..	..	3.45	14.60	..	..	..	..	..	..	..†
55		..	..	..	..	..	..	..	..	15.17	..	..	..	..	..	..	..†
56		..	..	..	..	..	..	..	..	14.08	..	..	..	..	..	..	..†
57		..	..	..	..	..	..	..	..	15.30	14.79	..	..	..	..	..	..†
	B	..	..	0.66	..	..	..	..	..	..	..	32	..	0.344	..	19.6	..†
	B	..	..	..	..	..	..	..	..	..	..	32	..	0.344	..	20.5	..†
	B	..	..	..	..	..	..	..	..	..	..	29	31.00	0.352	0.347	18.47	19.52†
58		..	..	0.68	..	..	..	..	3.50	Not sound.		..	..	..	..	..	..
59		..	..	..	..	..	..	..	..			..	..	..	..	..	..‡
60		..	..	..	..	..	..	..	..			..	..	..	..	..	..
61		..	..	..	..	..	..	..	..			..	..	..	..	..	..
	C	..	..	0.65	..	..	..	..	..	..	..	26	..	0.281	..	16.7	..‡
	C	..	..	..	..	..	..	..	..	..	..	27	..	0.273	..	17.2	..‡
	C	..	..	..	..	..	..	..	..	..	..	31	28.00	0.320	0.291	19.1	17.7‡
62		..	..	0.64	..	..	..	..	3.55	Not sound.		..	..	..	..	..	..
63		..	..	..	..	..	..	..	..			..	..	..	..	..	..§
64		..	..	..	..	..	..	..	..			..	..	..	..	..	..
65		..	..	..	..	..	..	..	..			..	..	..	..	..	..
	D	..	..	..	..	..	..	..	..	..	..	30	..	0.305	..	18.3	..§
	D	..	..	..	..	..	..	..	..	..	..	28	..	0.281	..	17.7	..§
	D	..	..	..	..	..	..	..	..	..	..	28	28.66	0.297	0.294	17.7	17.9§
66		..	..	0.65	..	..	..	..	4.00	Not sound.		..	..	..	..	..	..
67		..	..	..	..	..	..	..	..			..	..	..	..	..	..§
68		..	..	..	..	..	..	..	..			..	..	..	..	..	..
69		..	..	..	..	..	..	..	..			..	..	..	..	..	..
	E	..	..	0.66	..	..	..	..	..	..	..	25	..	0.285	..	15.2	..§
	E	..	..	..	..	..	..	..	..	..	..	24	..	0.254	..	15.3	..§
	E	..	..	..	..	..	..	..	..	..	..	22	23.66	0.234	0.258	14.2	14.9§

*Very hot. †Fairly hot. ‡Thick. §Very thick.

TABLE 6. TESTS FOR STRENGTH OF IRON HELD IN LADLE FROM 2 TO 22 MINUTES BEFORE POURING.

d^2 = Depth of bar squared in inches,

M = Bending moment $= \frac{WL}{4}$,

Z = Modulus of section $= \frac{bd^2}{6}$,

$$f \times \frac{b.d^2}{6} =$$

moment of resistance of bar to breaking,

$$f \times \frac{b.d^2}{6} = \frac{W.L}{4}.$$

Then

$$f = \frac{W.L.6}{4\,b.d^2} = \frac{1.5\,WL}{bd^2}.$$

The tests show that while the transverse bars themselves may slightly vary, when worked out to this test based on the exact area, there is very little variation with the increasing silicon in one case, and a fall in the strength in the other. On the other hand, in the case of the bars tested as cast and as machined, while the machined bars may show if anything a less favorable result, if the breaking weight of the bar is based upon the exact area and worked out to the moment of resistance, it gives upward of 10 per cent. better breaking load and 40 per cent. better deflection.

Transverse-test bars in Britain are of two sections, 2x1 and 1x1 inch, and the supports vary from 12 to 36 inches, and while it is not difficult to obtain an approximate comparison between these bars, it is very difficult to do so between our transverse bars and those of other countries. This difficulty could, however, easily be overcome by adopting such a test as moment of resistance, which is based upon the section of the test bar and length of bar between supports, thus reducing the tests of all sizes of transverse-test bars to one common comparative result.

Conclusions

1. The best tensile and transverse tests are obtained from bars which have been machined.

2. Transverse-test bars cast on edge and tested with the "fin" in compression give the best results in testing.

3. The transverse test is not so reliable or helpful as that of the moment of resistance.

4. The use of high-grade ferrosilicon in the foundry is of no commercial value.

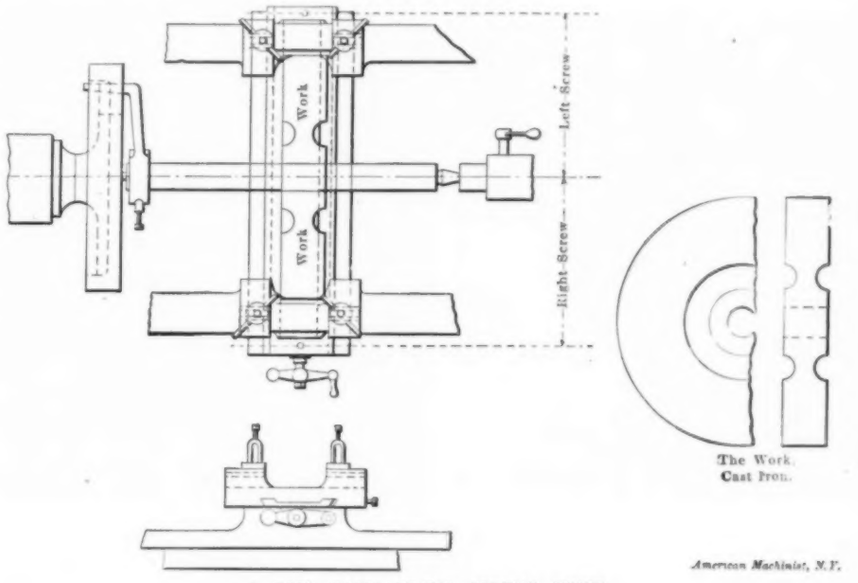
5. Cast iron gives the best results when poured as hot as possible.

The author wishes to thanks Messrs. William Gray & Co., of West Hartlepool, for placing their foundry at his disposal for these tests; and at the same time John B. Williams, their assistant manager, for the interest taken in the experiments; as well as his late colleague, George H. Hewson, for assistance in the analyses.

A Tool Carriage for Special Work

By Chipman

In the drawing is shown an arrangement the principle of which is probably as old as the machinist's trade. A few years ago we received a contract for a fairly large number of special automatic machines for making small cigars. Employed in their construction was the disk shown in the line cut which were required *exactly* 1¾ inches thick, and *all be alike*. "Exactly," and "all alike," meant within a thousandth or so. This required a special "rig." Contracts, with us are obtained on a very close margin of profit and brains, as well as hands, must be used to save time. Two tool blocks were cast as shown and machined. A square-thread screw was turned and threaded one end right hand, the other, left hand. The screw was shouldered at each end and in the middle and given three bearings. The cut, in elevation will show how these tool blocks were placed on the cross slide. The screw feeds the tool blocks either toward or away from each other. It would have been better had we arranged to have one of the blocks of each double block movable so as to provide for a larger range of work. The two roughing tools are set, as usual, on the front side and the cutting points spaced by scale. The finishing tools on the back side are set upside down and also spaced, for distance. The roughing tools, as usually set, will leave too much for the finishing cut, so we found it best to set them only about 0.015 inch farther apart than the finished size. The finishing tools must be tried and set and reset until correct. A boy can then handle the job successfully until the tools require regrinding, when the setting process must again be gone through. The center holes were drilled and reamed on the drill press and any slight variation in diameter, of course, is taken care of by the taper of the mandrel. This causes no trouble since by moving the carriage the whole arrangement is moved without interfering with the setting of the tools. All that is necessary is to see that both the roughing tools cut. We now use this arrangement on quite a variety of work such as disks, bushings, collars, etc.



A TOOL CARRIAGE FOR SPECIAL WORK

Sizing Duplicate Work on the Surface Grinder

By H. R. Gilliam

On the surface grinder where a number of pieces are to be ground and exact duplication of size is essential, I have a piece of iron of suitable hight fastened close beside the work in such position that it must not be moved when the work is changed, and as the first piece of work is sized the top of this "sizer"—as it is called—is also ground to the same hight.

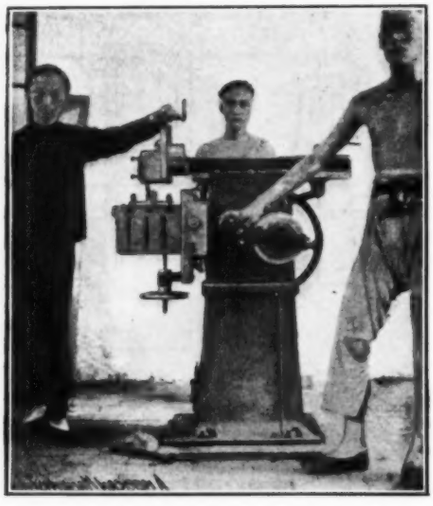
The first piece of work is removed from the machine and another piece is put on. The top of the sizer is then painted with copper (vitriol solution), which forms a very thin film, and to produce exact duplication of thickness in the work it is only necessary in approaching the exact size to bring the wheel over the sizer and just grind this film of color off the sizer until the iron shows its brightness under the coloring, then without taking any measurements the wheel, without further adjustment, is given the final pass across the work.

The results in extreme accuracy of duplication will be found surprisingly satisfactory.

A Chinese Machine Shop

By Texas

The article entitled "A Progressive Chinese Mechanic," which appeared some months ago, was very attractive to me, following as it did, some interesting talks which I had enjoyed with a gentleman recently returned from China, where he had been in the interest of an American concern that was introducing its goods into that country. They were working along the same lines as advanced by Mr. Hobart, in the above-mentioned article, namely, that it would be more profitable to establish branch manufactories in China, and employ natives, than to ship their manufactured product from this country. With this end in view, they had sent a practical man, of business ability, to open a factory on a small scale, and pave the way for future business. The difficulties he encountered in establishing a machine shop in a country almost void of machinery except in its crudest form, were most numerous. Inability to understand the language; relying on interpreters did not tend to make the task any easier.



TWO VIEWS OF A CHINESE MACHINE SHOP

But, being possessed of considerable Yankee ingenuity and tact, he managed to get together a squad of Chinese mechanics, and partially equip a small shop. Although only rudely equipped, the first order was completed and installed in much less time than had been anticipated.

At the low wages paid, from 30 to 60 cents per day for the best men, it would seem impossible for human beings to live, but owing to the cheapness of everything, it is not only possible, but they save money. As a sample of the cost of living Mr. Blank relates going to dine with eight of his men. They went into a Chinese restaurant, where they enjoyed a regular course dinner, served, of course, in Chinese style. Soups, fish, chicken, meats, vegetables, then more soup, finishing with Chinese confections and tea. The bill for the entire party was twenty cents. That is why a Chinaman can return to his own country with a few hundred dollars, and live a life of ease for the remainder of his lifetime.

The average Chinese mechanic is possessed of the crudest of tools, and the only wonder is, not as to how he does so well, but that he does at all. For instance, having occasion to have the carpenter build a box, it was first necessary for the carpenter to make a saw. Stretching a piece of piano wire across the ends of a piece of bamboo, bow-fashion, and nicking the wire with a cold chisel, he had a saw in a very few minutes. Owing to the scarcity of nails, the box was put together with pins of wood.

The only drills they had were the old fashioned bow drills as used many years ago. Having occasion to do some more particular drilling than was possible in this crude manner, a small hand drill was mounted on a frame, and operated by coolie power, while the machinist fed the work up by means of a lever as shown in the picture. Hunting around through the English quarters, an old shaper was unearthed and rigged up with two cranks turned by coolies, as shown in the illustration. Coolie power was all the power obtainable at this time but the intentions are to take over a gas engine.

One of the big Chinese officials decided that he needed a motor boat, as he had seen or heard of them, and nothing else would do than that Mr. Blank must build it for him. The boat was built all right, but the question of a motor was of greater import. This official did not want any gasolene engine, that was continually getting out of order, but would rather depend on coolie power, so Mr. Blank built him a coolie motor, namely three cranks on the propeller shaft, whereby three coolies could turn the screw. The propellor was made of sheet iron bent as near like the real thing as possible, with the facilities at hand.

In China nothing is allowed to go to waste. Every splinter of wood is carefully hoarded away and any metal carefully saved. If a hack-saw blade or file gets worn out, the temper is drawn and the teeth struck up with a chisel. It is then rehardened.

Chart for Weight of Stock for Small Screws

By Oscar F. Nilsson

From this chart the weight and length of stock required for an order of small screws can be obtained more quickly than by using a slide rule. No allowance is made by the chart for material lost in ends of bars, through imperfect screws made while setting up, etc. Each shop can add a percentage for such loss, 5, 10, or 15 per cent., as may be necessary.

The following example illustrates the use of the chart: Find weight of stock for 1000 screws, length 0.425 inch, diameter 3/16 inch. Add to length the width of the cutting-off tool, approximately 0.075 inch; sum = 0.500 inch. Follow angular line marked 0.500 until it comes between diameter lines of 0.185 and 0.190 inch, where on the nearest horizontal line read 39/10 pounds, or approximately 4 pounds. If you want the length in feet, it can be read where length line 0.500 crosses the line marked feet per 1000 pieces, which shows 41⅔ feet.

The Scarcity of Men

By Superintendent

We have been hearing a great deal lately about the scarcity of experienced men for factory management, trained operators, etc., and would ask if this is an absolute fact, or an idea that has originated in some parts of the country, due possibly to poor advertising for such help, and the inconsiderate way replies to advertisements for help are treated.

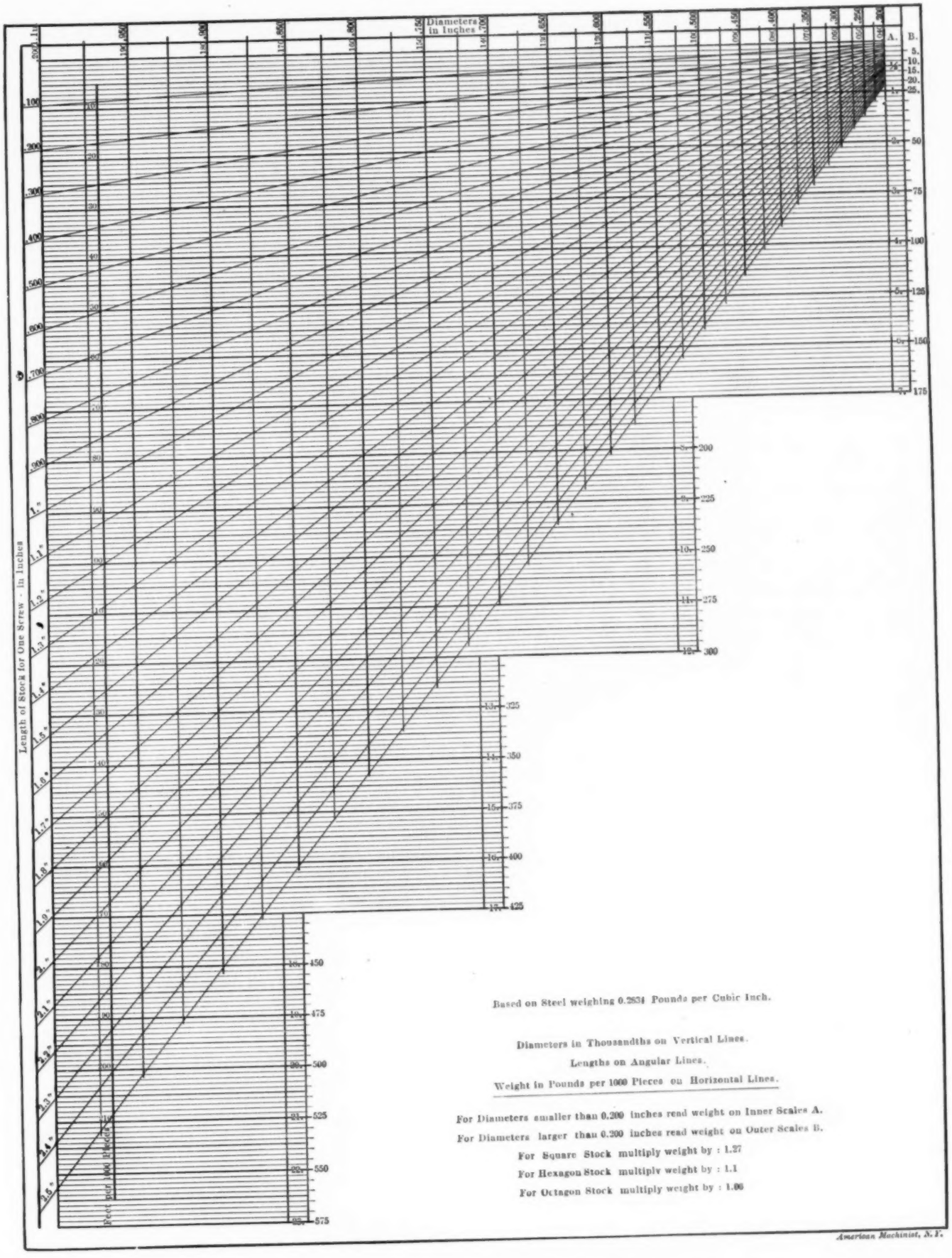
During the past summer I have been in a position to study this matter quite thoroughly from observing the following.

Two men of large caliber, one of them a production manager who has commanded $6000 per year, and the other a screw-machine foreman who has commanded $175 per month, have tried in vain to locate for two months.

These men have advertised and followed up advertisements, with this answer. "Too much money, we want cheaper men."

Does not this mean that cheap men are wanted, not "we cannot get men?"

I have hired many hundred men during my experience, and have found that, when men are wanted, they can be had, but, "good men are worthy of their hire."


Diameters in Inches
Length of Stock for One Screw - in Inches
Based on Steel weighing 0.2834 Pounds per Cubic Inch.
Diameters in Thousandths on Vertical Lines.
Lengths on Angular Lines.
Weight in Pounds per 1000 Pieces on Horizontal Lines.
For Diameters smaller than 0.200 inches read weight on Inner Scales A.
For Diameters larger than 0.200 inches read weight on Outer Scales B.
For Square Stock multiply weight by : 1.27
For Hexagon Stock multiply weight by : 1.1
For Octagon Stock multiply weight by : 1.06
American Machinist, N.Y.

WEIGHT AND LENGTH OF SCREW WIRE PER 1000 PIECES

A Transmission and Recording Dynamometer

Automatically Traces a Record of Torque in Inch-pounds and Number of Revolutions from Which Horsepower Is Easily Computed

BY JAMES W. HUGHES

The various kinds and styles of dynamometers now in existence are so numerous and multifarious, that one would be led to believe, on first thought, that this is a hackneyed subject for a technical magazine. But, after many years' of practical experience with a vast number of various kinds of dynamometers I have come to the conclusion that 98 per cent. of all I have thoroughly tested or calibrated, are not worth the laboratory space they take up. It is safe to say that the result obtained from an average dynamometer is by no means as reliable as a shrewd guess of an experienced engineer.

Under these circumstances, while in charge of experimental work for a former employer, I sorely felt the need of a reliable power-measuring machine or, more especially, some reliable device that would automatically record the torque produced in a shaft while the shaft was rapidly revolving. At this point I was instructed to produce such a machine for the express purpose of delicately testing out various forms of a slip pinion, such as is commonly used to relieve shocks on silent-chain drives.

The task was successfully accomplished, and the first machine built is now in the laboratories of the University of Pennsylvania, where it is known as the "Hughes dynamometer." This dynamometer having fully come up to all expectations and requirements, I hereby respectfully submit the results to the readers of the AMERICAN MACHINIST.

A Fault in Brake Dynamometers

Before taking up the general principles and designs, let us first look into at least one principle common to almost every form of brake dynamometer, which proves to be a serious fault of such a magnitude as to make them utterly unreliable, if not worthless. The following important principle has never been pointed out by any of the authorities (?) or writers on the subject of dynamometers, so far as I have been able to ascertain.

First, let us take the case of an ordinary Prony brake dynamometer: On several occasions I have tested various types and obtained results showing anywhere from 105 to 120 per cent. efficiency. The ridiculousness of the results required a solution of the mystery, but the enigma was never solved until one day, while calibrating a certain form of dynamometer, the following paradox was obtained: In Fig. 1 S represents a shaft, mounted in two bearings $B\,B'$, carrying two levers arms $A\,A'$, each exactly 50 inches long from center

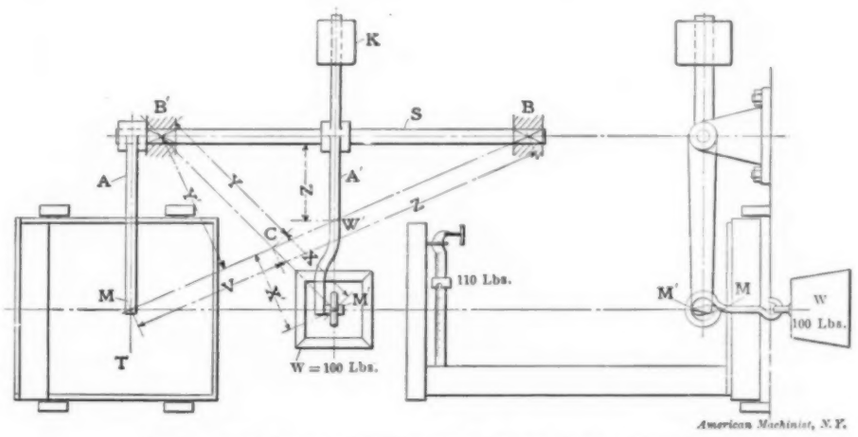


FIG. 1. DIAGRAM OF PRINCIPLE OF A BRAKE DYNAMOMETER

of shaft to the fulcrums $M\,M'$, respectively, and firmly keyed to the shaft. At K is represented a counterweight which balanced the two lever arms and brought the center of gravity about the center line of the shaft S; T represents a platform scales and W represents a weight, which weighed 100 pounds when placed on the scales T.

When W of 100-pounds weight was hung on the fulcrum M', the scales just balanced at 110 pounds.

At first the paradox almost paralyzed the brain, but on closer examination the mystery was easily solved, as follows: Considering A and A' to be firmly keyed to the shaft S, then the two arms and shaft S become practically one solid mass. Therefore, when any weight W is placed on the fulcrum M' of the lever A', the whole mass will tend to rotate about a line passing through the points of support M and B, with a moment of W times the lever arm X'. The shaft S at the point B' will be fetched forcibly up against the top of box or bearing cap of bearing B', which will resist the rotation of the mass about $M\,B$, with a balancing moment equal to $W\,X'$, or a reaction on the bearing cap equal to $\frac{W\,X'}{Y}$ or $\frac{W\,X}{Y}$.

Now, it is evident that the resultant of these two forces is a downward vertical force C at the point C equal to $W + \frac{W\,X}{Y}$, which load is distributed between the points of support B and M inversely proportional to their respective distances from the point C. Hence the load on the scales T will be represented by $\frac{Z}{(V+Z)\,C}$ or $\frac{Z}{V+Z}\left(W + \frac{W\,X}{Y}\right)$. Hence a weight of 100 pounds on the fulcrum M will produce a load on the scales T equal to $\frac{Z}{V+Z}\left(100 + \frac{100\,X}{X}\right)$ instead of 100 pounds as generally believed.

The above condition obtains, more or less, in the vast majorities of dynamometers, and is sometimes so exaggerated as to make the results positively ridiculous. In the case of a motor test let W represent the tangential pull on the armature, an equal upward pull on the opposite side of the shaft might tend to balance the error, or it might tend to make matters worse, depending upon the position of the other points in the diagram, but wherever W may fall the results will be most erroneous.

For instance, suppose that W happens to fall on the line $M\,B$ at W'', then it is evident that the weight exerted on the scales T will be equal to $\frac{W\,Z}{V+Z}$, instead of $\frac{N\,W}{L}$ as generally accepted.

Description of the Hughes Dynamometer

We will now take up the description and discussion of my dynamometer, in which the above bad features, as well as many other bad features of dynamometers are entirely eliminated.

Fig. 2 represents diagrammatically the entire workings of the machine under discussion. At X, Y and Z are silent chain-drive wheels of different sizes to give different speeds, keyed to the quill of a spring cage U, which in its turn is delicately bal-

anced on a pair of strong, high-class ball bearings *A A*, *B B*, *C C*. The spring cage *U* carries a spiral spring *V*, one end of which is attached to the spring cage *U* and the other end attached to the cam hub *W*, which is, in its turn, firmly keyed to the shaft. The cam hub *W* carries a cam lever *Q* perfectly balanced on a pivot point of support.

A specially made cord *T*, out of which all the "stretch" has been taken by subjecting it to a stress of about 100 times its working load, is attached at one end of the lever *Q*, passes over the two little sheaves *S S'* through the center of the main shaft and attaches at the other end to the small shaft or drill rod *F*. The other end attaches by means of a swivel to a little crosshead *D'*, which carries a recording pin that works on a roll of paper passing over the master roll of the recording instrument, the description of which will be given further on in this article.

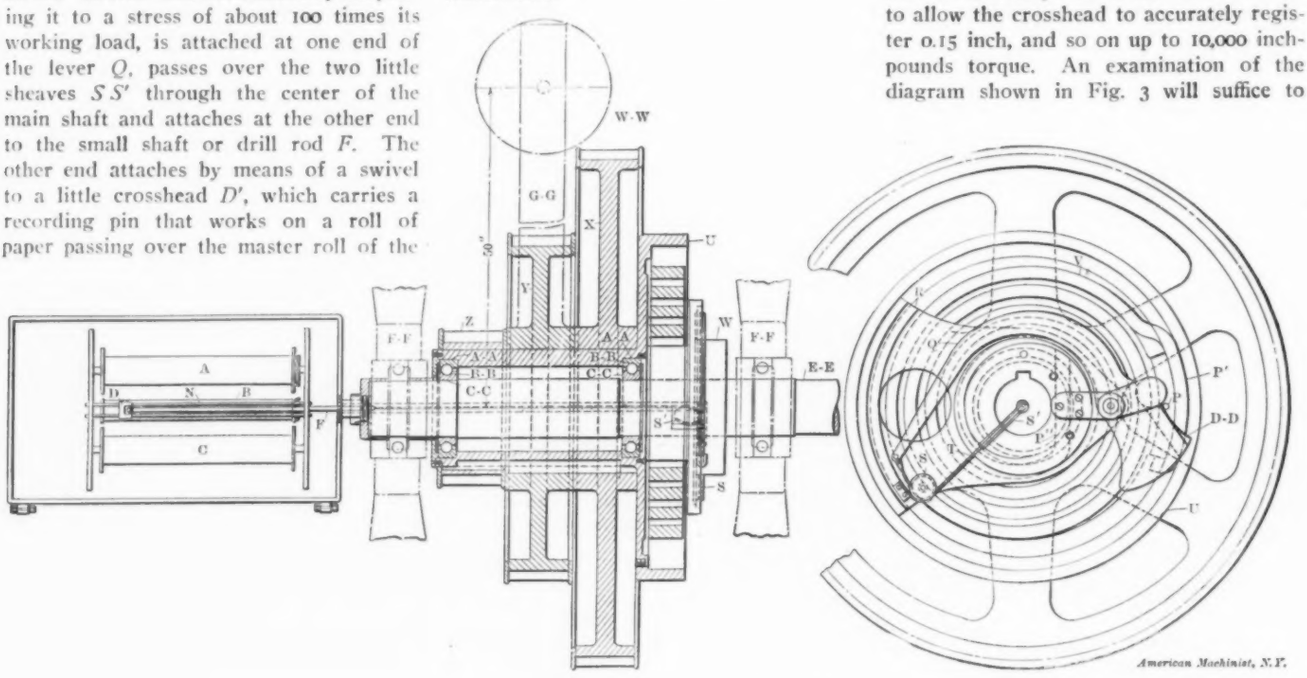


FIG. 2. DIAGRAM OF HUGHES DYNAMOMETER

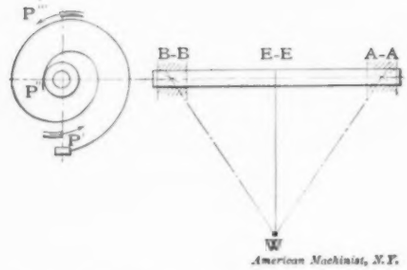


FIG. 3. DIAGRAM OF SPRING AND CALIBRATING WEIGHT OF HUGHES DYNAMOMETER

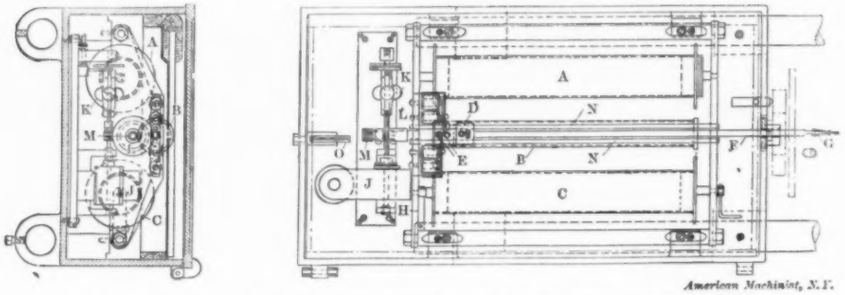


FIG. 4. DIAGRAM OF RECORDING INSTRUMENT OF HUGHES DYNAMOMETER

Action of the Machine

The action of the machine is as follows: In testing a motor or engine the motor or engine is made to drive the spring cage or quill *U* through a silent chain or belt driving on wheels *X*, *Y* or *Z*, according to the speed desired or necessary. The torque produced in *U* is transmitted into the shaft *E E* through the spiral spring *V*, one end of which is "fixed" to *U* and the other end is "fixed" to the cam hub *W*, which is keyed to the shaft *E E*. The shaft *E E* drives by any convenient method any kind of power absorber desired, from an ordinary prony brake to a dynamo. The style of brake on *E E*, or the position of the shaft bearings *F F* play no part whatever on the results. Now, it will be clearly seen that the spring *V* will deflect practically proportional to the torque transmitted through the whole arrangement, and will allow the spring quill *U* to chase around the shaft *E E* on the ball bearings *B B*, and the angle of deflection will be proportional to the torque carried or transmitted.

Now, as *U* is moved with respect to *E E*, the pin *P* (which is carried in the steel casting of the spring cage *U*) presses against the cam *D D* on the cam lever *Q*, which operated the little crosshead *D'* of the recording instrument through the cord *T* and swivel shaft *F*.

The curve *D D* was determined, or rather the machine was calibrated, as follows: On the quill of the spring cage *U* was keyed a lever *G G* (50 inches in length) between the ball bearings *B B*, *B B* in the place of the driving wheel *Y*. Next weights *W W* are hung on the end of the beam *G G*, advancing by 1 pound per setting. A 2-pound weight at the end of *G G* will produce a torque of 100 inch-pounds and advance the pin *P* to a new position on the cam *D D*.

Beneath the crosshead *D'* was clamped a scale reading in hundredths of an inch. Now, since 1 inch on the record paper represents 1000 inch-pounds, 1/10 inch would represent the 100 inch-pounds, hence the cam *D D* was filed under the new position of the pin *P* till the crosshead *D'* registered exactly 1/10 inch on the scale.

Then another pound weight was added and the second point on the cam was filed to allow the crosshead to accurately register 0.15 inch, and so on up to 10,000 inch-pounds torque. An examination of the diagram shown in Fig. 3 will suffice to show that no false reaction can be recorded.

The load *W* with its counterbalance and shaft *E E* must be supported by the ball bearings *B B* and *A A*. The spiral spring *V* which takes the reaction, being fixed at both ends *P'* and *P''*, can only produce pure torque, since the reaction upward at *P'* which tends to thrust the shaft *E E* upward against the top of the bearing *B B* is counterbalanced by the equal and opposite force at *P''*, acting downward and tending to force the shaft against the bottom of the bearing *B B*.

The Recording Instrument

The recording instrument is shown assembled in Fig. 4. The working of the instrument is as follows:

At *B* is represented a master roll driven by a small electric or spring motor *J* through a worm and gear *M* and *L*. At *C* is a roll working under the friction spring *H* and carries a big roll of paper graduated in tenths of an inch. At *A* is the receiving roll on which the paper winds as the record is made.

Roll *A* is driven by means of a small, round, rubber belt which slips as the roll on *A* increases in size, thus allowing the paper to pass uniformly over the master roll *B*.

At *K* is a governor, which controls the speed of the recording instrument, allowing the paper to pass under the recording pens at a constant speed of 10 inches per minute.

Pen *D* is a recording pen, made of glass; *E* represents two recording pens

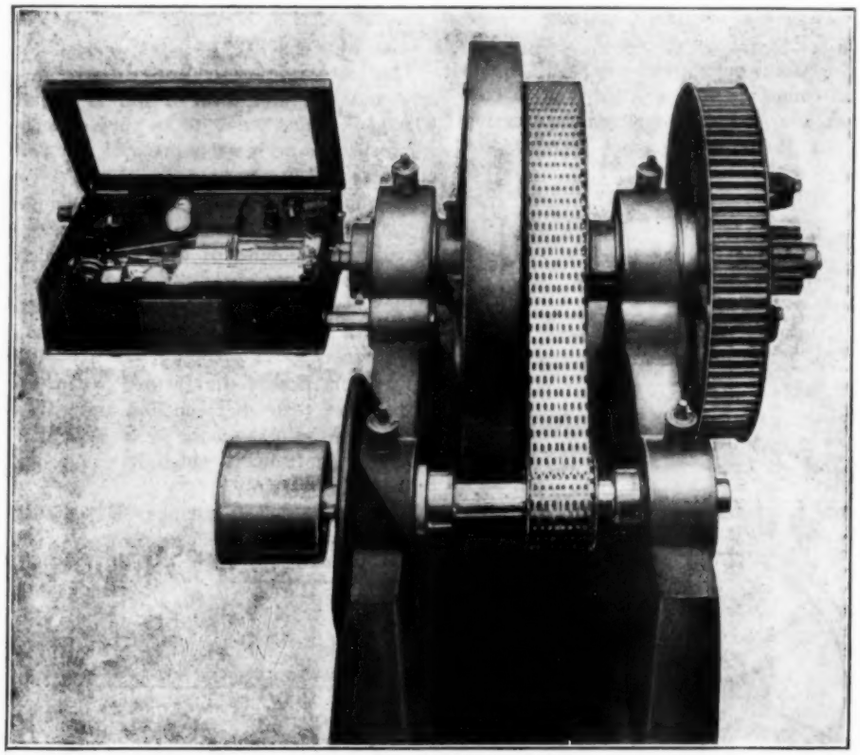


FIG. 5. THE DYNAMOMETER COMPLETE

operated by magnets *E'*, causing a dot or kink to be made every revolution of the machine, one recording the revolutions made by the driver, the other recording the revolutions made by the driven, thus showing the slip of a belt or slip pinion, as desired.

At *O* is a small sheave, inside of which is a watch mainspring, and around which winds a chain, one end of which is connected with the crosshead *D* and keeps the crosshead pulled snugly down with a constant tension on the cord *T*.

As the dynamometer automatically records the inch-pounds torque and the number of revolutions per minute, the horsepower can easily be calculated from the record paper without any further data by the old formula $Horsepower = \frac{TN}{63{,}020}$, where T = torque in inch-pounds and N = number of revolutions per minute.

It must be admitted that the dynamometer above described is somewhat expensive in construction, nevertheless the advantages gained by building such a machine are well worth the excessive cost over the ordinary type of dynamometer. Fig. 5 is reproduced from a photograph of the finished machine.

Measuring Screw Threads

By F. J. McDonald

About a year ago I made and am now using a triangular prism of tool steel, shown at Fig. 1, for measuring screw threads which are too large for the ordinary thread micrometers. It has proved to be so simple and satisfactory to me that I consider it worthy the attention of the rest of the craft. A glance at Fig. 2 will show how it is used.

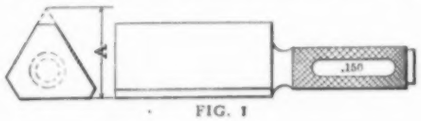


FIG. 1

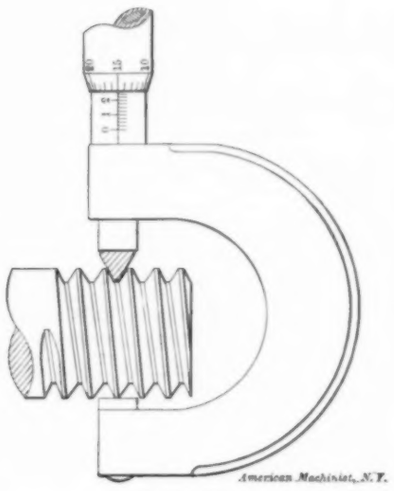


FIG. 2

MEASURING SCREW THREADS

The formula that goes with it is so simple that anyone can use it without much fear of making a mistake. The formula for a U. S. standard thread would be. Outside diameter tap +

$$A - \frac{0.7577}{No.\ Threads\ per\ Inch}$$

when the thread is of the proper depth, *A* here being the distance *A*, Fig. 1. For a V-thread substitute 0.866 as a constant.

Example: Required reading for a ¾ diameter 10 pitch U. S. thread tap. Assume distance *A*, Fig. 1, to be 0.150. Then $0.750 + 0.150 = 0.900$ and $0.7577 \div 10 = 0.07577$ or 0.0758 then $0.900 - 0.0758 = 0.8242$, which is what the micrometer should read when the thread is of proper depth and the tap correct as to the outside diameter. If the tap be slightly over or under size as sometimes happens, it is best to use the formula as though it were correct. Then make deductions from or additions to the result accordingly as the tap is over or under size.

That is to say, if the tap be 0.002 inch under size subtract 0.002 from the reading. Or if it be 0.002 over size add 0.002. This would bring the threads to the standard diameter regardless of the outside diameter of the tap. The micrometer is the only measuring instrument required in making the device. I usually finish the triangle to within 0.001 over size, then harden and lap to size. This obviates any danger of crushing the sharp corners when measuring. Then I stamp the size on the handle which has been left soft for that purpose, after which I grind off the corners so that the triangle will not touch in the bottom of the thread. If care is taken to grind a proportional amount from each corner a great range of threads may be accommodated with the one instrument.

Constant 0.7577 is derived from the fact that a U. S. standard thread of one inch pitch cut sharp in the bottom like a V-thread is 0.7577 deep.

According to a careful road census, the length of all our roads amounts to 2,155,000 miles. The most liberal estimate of our annual expenditures on these roads, both in money and labor, was a fraction over $79,000,000 in 1904, or about $1.05 per capita. At the same rate this would be about $90,000,000 a year at the present time.

Practical Letters from Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

An Emergency Pump Repair

As engineer of our home water supply it was recently up to me to find out what was the matter with the windmill which was apparently working all right but not furnishing the usual quantity of water.

Several times I had been obliged to reprime it after it had been idle for a day, and finally suspected something wrong with the plunger. Examination showed that the cup leather of the pump piston was worn out on one side and worthless.

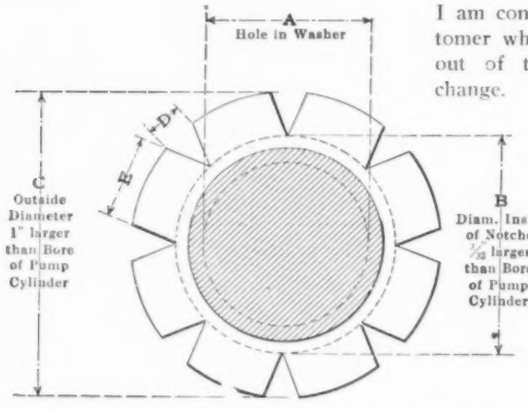


FIG. 1 AN EMERGENCY PUMP REPAIR

We were out of water and could not get a new cup leather until the following day. I had nothing on hand but some good box-calf trimmings from the shoemaker's bench which I use for various jobs, and finally decided to improvise a cup leather from this as follows: I cut a washer 1 inch larger in diameter than the pump piston, making the hole slightly smaller than the threaded portion over which I worked it to the shoulder and then screwed the ring up tight holding it securely, though there was only 1/16 inch margin all around. I then cut notches all around, as shown in Fig. 1, making the width of each notch *D* equal to the difference in circumference of *B* and *C* divided by the number of notches, leaving about 1 inch space *E* between. The notches were not cut until after the washer was secured to the plunger, so that there would be plenty of leather to prevent the washer from spreading.

When pushed into the pump cylinder after being thoroughly wetted the flat portion curled up slightly closing the notches tightly as in Fig. 2. The best I hoped for the job was that it might answer fairly well for a day or two until I could get a regular cup leather. It has, however, been running for over two months, pumping against 70 feet head of water, and apparently doing as good work as the regular leather ever did, and I am inclined to leave it and see how long it will last. I hope this experience may help someone else in a similar emergency.

Westtown, Penn. GYMNITE.

What Steam Engine Pistons Endure

The steam-engine concern with which I am connected had a letter from a customer who complained about the wearing out of their pistons, and suggested a change.

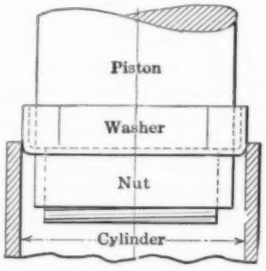


FIG. 2

In looking over the history I found that the engine was 12-inch stroke, ran 300 revolutions a minute, and had been running nine years.

There was nothing unusual in this, as no doubt all builders can show as good, or better, records; but assuming, as probable, the engine had run 10 hours a day for 300 days in the year, that piston had traveled no less than 184,000 miles in the cylinder. Probably readers will not want to credit this until they have confirmed the figures.

This seemed to be such a revelation to me that I began investigating, and found that one party had one of our engines of 16-inch stroke that was put running January 1, 1893, and has run 24 hours a day for 6 days in the week, 200 revolutions per minute, for over 16 years, making a journey all told of over 696,000 miles. Is it any wonder that pistons and rings and cylinders wear out?

New York, N. Y. SUPERINTENDENT.

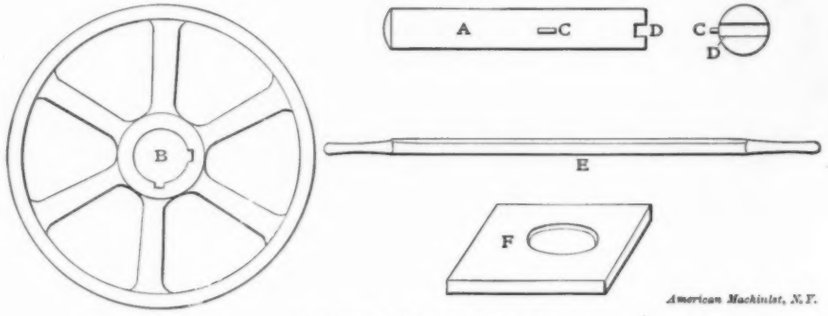
Boring a Flywheel Using a Wooden Boring Bar

The reboring of a flywheel 8 feet diameter and weighing over a ton is a job which everyone knows to be very difficult when there is no suitable machine, such as a boring mill at hand.

The accompanying cut shows a simple appliance which was used, with success, to enlarge the bore of this wheel which was part of some plantation machinery, made here and shipped to a South American country in a knock-down condition.

By a mistake at the factory the wheel had slipped through inspection and to its destination with the bore 1/8 inch smaller than the shaft upon which it was to be mounted.

There was not a machine shop within 300 miles of the place of erection, but started that machinery must be, so this make-shift was resorted to.



THE WORK AND THE TOOLS

A block of hardwood *A* about four times the length of the bore *B* was carefully shaped to fit it. A file *C* was broken off and ground on the end similar to a boring tool, and was then driven into the wooden arbor *A* about midway between the ends and allowed to project just half the amount which the size of the bore *B* was to be increased.

By putting a notch in the end *D* a long handle *E* was fitted into it. The handle *E* was then turned round and round by several South American negroes, which are plentiful in those parts, and who, at the

same time, exerted a downward pressure upon it.

When the cut had advanced about an inch a block of hardwood *F* large enough to allow having a hole put through the center of it to fit *A* was clamped on top of the hub. This acted as a guide. It might be well to state that the chips had no trouble in escaping through the two keyways, thereby causing no trouble while cutting.

This satisfactorily completed the job in a remarkably short time; and after being set up, the wheel was found to run about as true as though it had been bored on a machine especially designed for the purpose.

Cleveland, Ohio. A. DANE.

Making Cabinet Drawer Pulls in the Punch Press

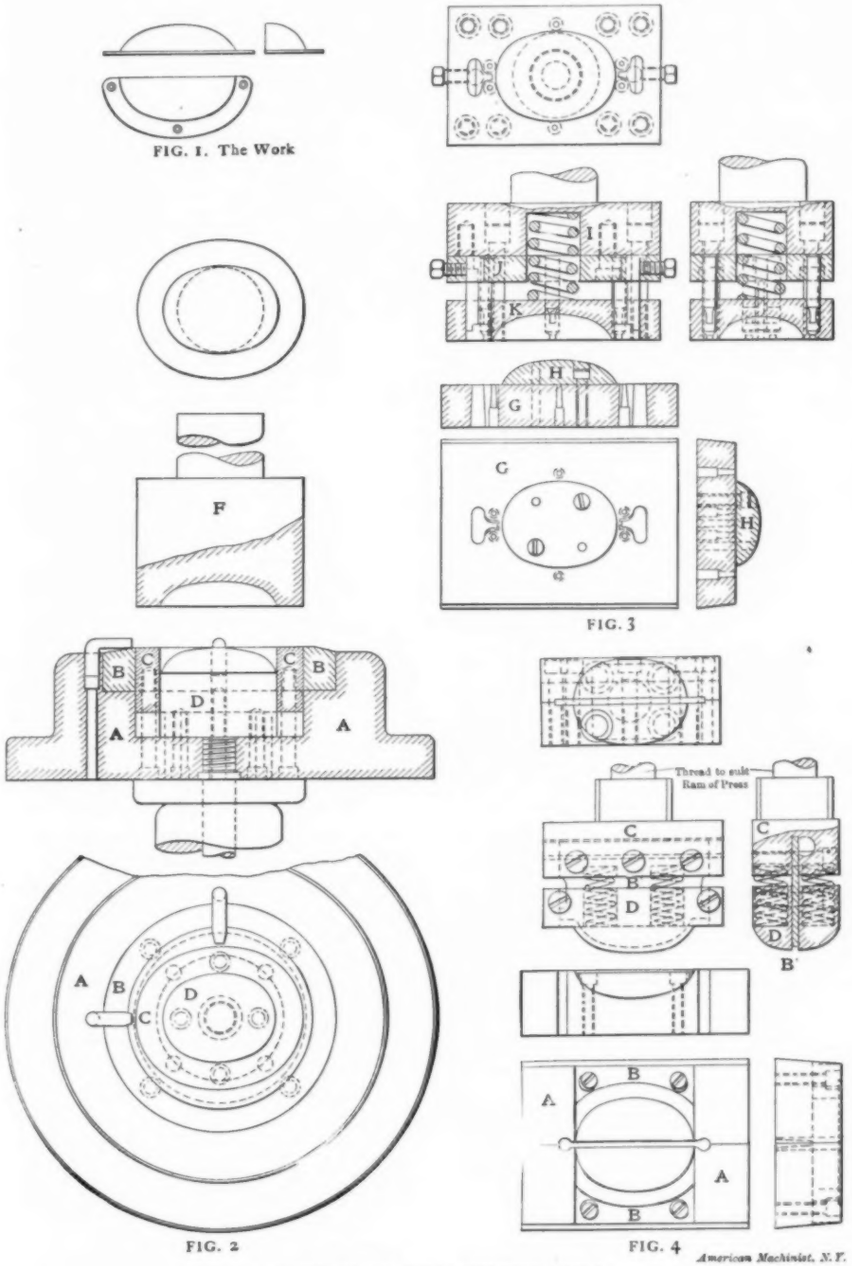
The drawer pull to be produced is shown in Fig. 1. If the sketch be examined it will be seen that the blank is not a convenient one to locate, whether it be desired to raise it in the press or stamp it under the hammer. But if two of them be placed together an article is formed which is readily raised to shape in either the stamp or the press. Therefore, the tools were designed as shown in the drawings herewith to handle two pieces in one.

Fig. 2 represents the combination, cutting and raising tools, in which *A* is the bolster, *B* the cutting die, *C* the pressure ring or blank holder, *D* the raising punch. *B* and *D* are fixed to *A* with fillister-head screws, as shown; *C* is provided with fillister-head screws which hold it in position and also limit its travel; *E E* are the four drill-rod pins which serve to transmit the pressure of the rubber buffer to the ring *C*. The buffer is of the usual type and is fixed in the manner shown. The punch itself, *F*, shown in plan and partial sectional elevation, calls for no comment.

Fig. 3 shows the piercing tools, the piercing being the second operation. The die *G* is of tool steel, of a size to fit a standard bolster. To it is fitted a locating piece *H* which is held by screws and dowels. In addition to the holes for screws, six in number, in the two articles, it will be noted that two other openings are provided; these serve to round the corners of the work, and also commence the parting of the one article from the other. The punch part of these tools entails rather more work, as will be seen from the drawing, where *I* is the punch holder, *J* is the punch pad and *K* is a pressure plate to which pressure is applied by the stiff spring at its center. The six small piercing punches are a force fit in the pad *J* and are headed over at their upper ends. The two formed punches have a round shank, and are a good fit in *J* which is tapped for set screws to prevent their withdrawal. The pressure plate *K* is hollowed out, so that it takes a bearing on the flange only of the two articles. Both *J* and *K* are held in position by four fillister-head screws.

The parting tools, in Fig. 4, include some features which may be of special interest. In the piercing operation the blank is manipulated with its raised part uppermost, but in this operation it is reversed, being held with its raised part downward. *A A* is the die, which is made in two pieces to facilitate grinding when necessary. It is fitted with locating pieces *B B* which have their screw holes elongated to allow of their readjustment when the die halves are ground. In making the die the two pieces were placed together after being machined all over to size, and then they were machined across the two to fit the curve of the work, the cutting space being machined afterward. Two holes were drilled through the halves on the parting line, thus providing clearance for the wheel when grinding.

The upper part of these tools is made to fit the hand press. It consists of *B'* the punch, *C'* the punch holder, and *D* the blankholder. After the punch holder had been machined all over a hole was drilled through it lengthwise and into this on one side was milled the slot for the punch. Three holes were also drilled for fillister-head screws which hold the punch in position. The punch when machined was left a little thicker than its proper size, and ground to size after hardening. *D* is made in halves, and the two fillister-



CABINET DRAW PULL PIERCING TOOLS

head screws which hold the two parts together, also, by reason of the shape of the punch, hold it in *D*, as shown. Four holes are drilled in *C* and *D* and these are provided with springs. The drilling of the lengthwise hole in the punch holder allows of the easy insertion of the punch, and also allows the holder to be easily screwed up solid. In operation, six articles are produced in these tools in three blows, whereas handling them singly, the old way, six articles required 18 blows, so that a greater output soon followed their introduction.

W. L. WOLFRAM.

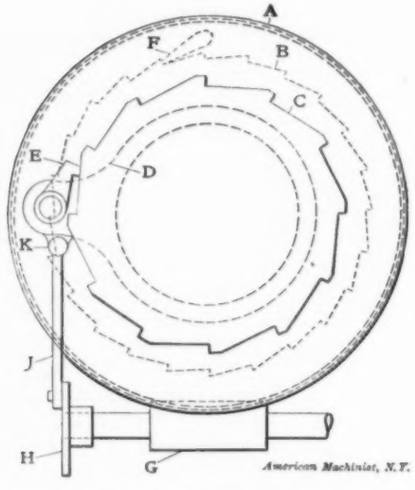
Manchester, England.

Time Saver for Milling Machine Turret

About a year ago I came across the device shown in the accompanying sketch. It may be used in conjunction with a milling-machine turret and is a certain time saver.

A is a worm wheel, carrying pawl *F*, and is rotated at constant speed by the worm *G*. *B* and *C* are ratchet wheels which run "solid"—a matter of detail design. *D* is an oscillating plate which carries pawl *E*. The crank *H* is attached to the worm shaft and operates the connecting rod *J*. The joint at *K* is, of course, universal.

The action of the device is as follows: The worm wheel *A* rotated by the worm



TIME SAVER FOR MILLING-MACHINE TURRET

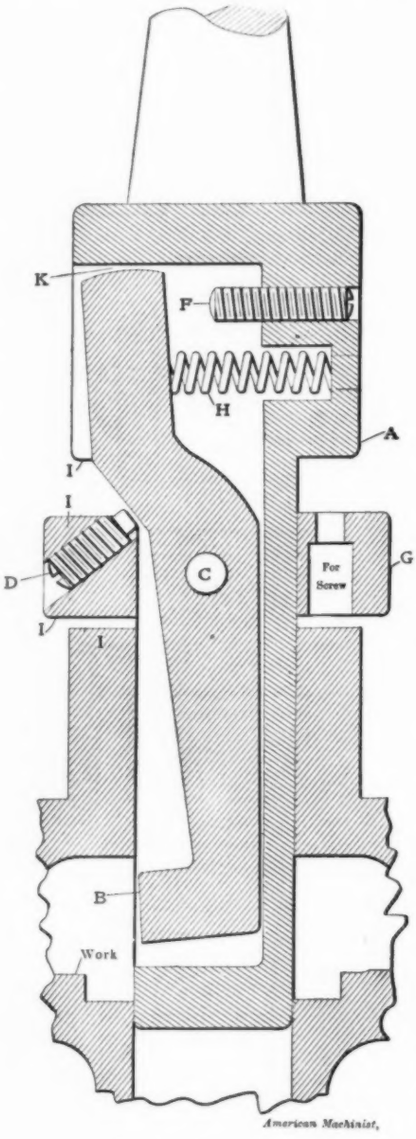
G in turn slowly revolves the ratchet wheels by means of pawl *F*, until such time as the pawl *E* engages with a tooth. Then on the downward stroke of the connecting rod *J* the ratchets are revolved part of a revolution much more quickly on account of the difference in the diameters of the respective ratchet wheels.

Glasgow, Scotland. J. H. JOHNSON.

An Adjustable Inside Facing Tool for the Drill Press

The cut shows in section a facing tool for inside work on the drill press. The operation on this work was always made in a lathe where it required a skilled man. A man with very little skill can do the same job with greater output now.

A is the body of the tool holder (a round piece of tool steel) in which a slot was made for the facing tool *B*. *C* is the pivot pin. *D* is an adjusting screw. After the tool *B* is ground it can be adjusted



AN INSIDE FACING TOOL

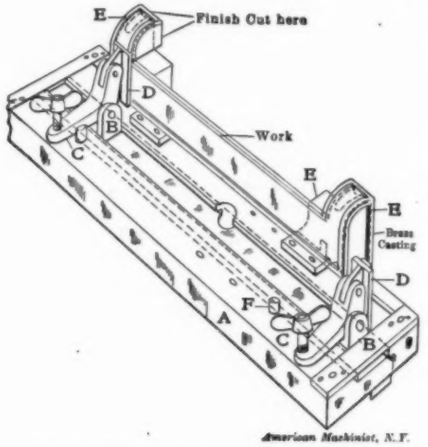
to the required size. *F* is also adjustable to prevent the tool going too deep. *G* is a sliding stop collar on *A* (screws not shown). *H* is the spring which holds the tool *B* within the holder body *A* and strips the collar *G* down, after the work is done. When the faces *IIII* are together the work is done.

The tool *B* was also fitted to bear on *K* to prevent the quick wearing on the pin *C*. It will be noticed that the tool holder on the lower end is not cut through so as to make it more solid. The tool was used on brass, but there is no reason why it should not work on other materials.

Freeport, Ill. CHARLES EISLER.

A Milling Fixture for an Odd Casting

The fixture illustrated was designed for use in end-milling the finished portions



MILLING FIXTURE FOR CABINET TOP CASTING

of several sizes of a long flimsy brass casting used in metal cabinets.

The device is composed of a cast-iron base *A*, which is provided at the under side with a tongue to fit the groove on a plain milling machine, and on the top with a dovetail groove running the entire length of the base. In this groove slide two machine-steel blocks *B* which are fitted with hinge bearings on which rock the clamp levers *C*. These levers are of machine steel and are provided at the outer end with a substantial screw and wing nut for operating the clamp. At the other end they are equipped with hinge bearings supporting machine-steel clamp screws *D*, which press the brass casting against the machine-steel blocks *E*. The clamp shoes are fitted with fiber pads in order not to mutilate the brass casting when clamping. These clamps and their supporting blocks slide sideways far enough to clear the ends of the brass casting and permit of its removal.

The block *E* on the right-hand end of the fixture is movable toward the left by removing the screws and setting the blocks over the required distance. The right-hand stop pin *F* is also capable of being moved over. This allows of machining short, medium, or long castings in one fixture.

The fixture is mounted on a plain milling machine with elevating slide and the cut is made with an end mill, first on one end and then on the other. The hole in

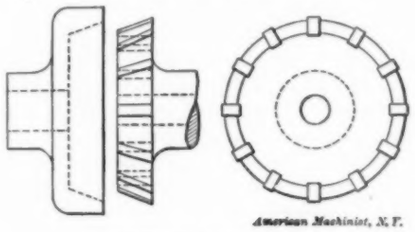
the middle of the fixture is for clamping it to the platen of the milling machine. All machine-steel parts are carbonized and hardened.

Cleveland, O. C. NOSRAC.

Repair on Planer Friction

The friction feed of the planer had worn considerably, so that it would no longer move the feed mechanism.

Some quick repair had to be devised for there was considerable work ahead of the machine and we could not wait to get a new casting made and machined.



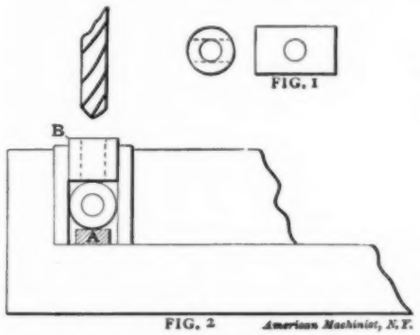
A FRICTION DRIVE REPAIR

The worn part was removed and put in the vise of the milling machine and twelve slots milled as per cut. Pieces of red fiber were driven tightly into the slots and cut down until they projected about a thirty-second of an inch above the metal. On assembling we found it worked so well that we did not bother about making a pattern to have a new one cast.

Pontiac, Ill. S. V. B.

Drilling Central Holes at Right Angles in Round Stock

Fig. 2 shows a scheme for drilling a hole central through a shaft or bushing without



DRILLING HOLES AT RIGHT ANGLES

the use of a jig. As here shown we had four small bushings, Fig. 1, which needed to be made fairly accurate. *A* is a parallel block supporting Fig. 1. *B* is the drill bushing which is clamped in a miller vise with Fig. 1. The usual spotting drill and reamer drill are used and the hole finished with rose reamer. The bushings after reaming the cross holes are returned to the lathe and finished to length and central with this hole. The stock chosen for the bushings was the same diameter as the drill bushing.

Detroit, Mich. CY. PRESS.

Men with Brains not Wanted

We hear a lot relative to the use of brains in the workshop. With the advent of the American firms and methods to this country, it was generally expected that brains would be at a premium.

The following case shows the reverse to be true with regard to the employees of a certain firm in London having American heads and English workmen:

A smart toolmaker in their employ showed them several things of general practice in good tool making which they knew nothing about. He also told them of different things of his own design and, being green, asked for some recompense, which was flatly refused.

After putting forward a sketch of a simple tool that was an improvement on the one they were using for a particular job, he was thanked by the foreman and told that the management were quite satisfied with what they were using. The toolmaker sent it to the editor of the AMERICAN MACHINIST; it was accepted and appeared about six weeks later.

The same day that particular issue of the AMERICAN MACHINIST got to the shop a tool of the design described in the paper was ordered to be made, was used, and found to be a great improvement.

Two or three days after the toolmaker was sent for and told by the manager that he must submit any further manuscript to his foreman and get his permission before he sent it to the AMERICAN MACHINIST.

If this man had been approached and asked to submit his manuscript to the firm first, and told that they would pay him for any article they wanted to keep and return him the rest, the matter could have been settled in a proper spirit.

Upon the next article appearing with this man's signature he was paid off and told to clear out.

Birmingham, England. J. DAVIS.

A Stroke Adapter for the Power Press

The adapter shown in Fig. 1 was designed and used for reducing the 1½-inch stroke of power presses down to ⅜-inch stroke suitable for piercing and blanking tools, working in a subpress.

It was not advisable to put in a different crank shaft, so some of these adapters were added to the power-press equipment, for use on subpress work.

Fig. 1 shows the adapter, partly in half section and consists of a mild-steel, case-hardened, flanged shank *A* to fit the recess in the ram. This is bored and counterbored for *B* which is a mild-steel case-hardened center bolt and nut. *C* are fiber washers between the points of contact. The head of the bolt engages in the slotted head *D* of the subpress.

Fig. 2 shows the adapter in position in the power press. The up stroke of the press takes up the extra length of the center bolt, before it lifts the top bolster of pillar press, while the down stroke is given with the full force of the ram face; the power press acting upon the sub- or pillar-press with the last ⅜ inch of its up and down strokes. This is a very handy device and easily adapted to other press tools where a shorter press stroke is temporarily required. It can be designed

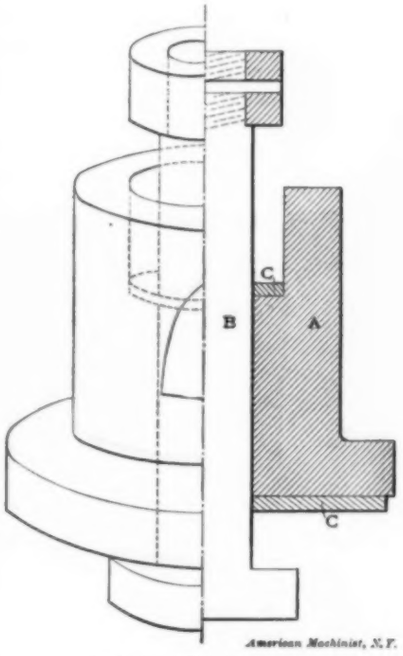


FIG. 1. THE ADAPTER

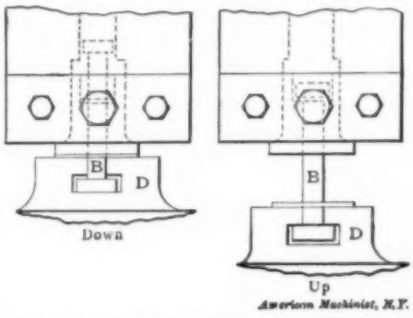


FIG. 2. THE ADAPTER APPLIED TO THE PUNCH PRESS

to give any length of stroke shorter than the original stroke of power press.

London, S. E. H. HARRIS.

In 1906 there were 51,000 locomotives on the railroads of the United States, and it is estimated that these locomotives consumed during the year 90,000,000 tons of fuel at a cost of $170,500,000.

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

Cape Cod Windmills

The paper in a recent issue of the AMERICAN MACHINIST by Snowden B. Redfield on "Some Ancient Windmills on Cape Cod" is of greater interest than some of your readers may perhaps realize. Having had the privilege of an opportunity to look up the history of some of the earlier attempts of the Plymouth colonies to provide mechanical power for themselves, I may be pardoned for calling attention to these interesting efforts.

The windmills erected all along the shore settlements of that part of Massachusetts familiarly known at the present time as the "South Shore," were, of course, the beginning of engineering in New England and, therefore, especially interesting to the descendants of these hardy and competent colonizers. To those who have not been in the locality named, it may be well to say that the topography is flat, and that while there are frequent streams or brooks which flow across it to the sea, these have their sources in chains of comparatively low hills a short distance inland and wind their way seaward without either falls or rapids of much consequence. Water power as we know it was not available for mechanical purposes. The Indians not only taught the early settlers how to produce the so-called Indian corn, but also how to crush or grind it by pounding between two stones or in the mortar with a pestle. Consider for a moment what this must have meant to the family. That the mortar and pestle was an important part of the household equipment is realized by reading some of the old wills. To quote from one: "To my daughter Elizabeth, one great mortar and pestle, and one great kettle."

Records show that the first attempt to do by mechanical means that which had before been done by hand, was the crushing of the corn produced on these shore farms. The earliest record along this line was a windmill erected in Plymouth before 1632 to crush the corn by *pounding*. About 1636 William Gillson erected in Scituate, at a place known as Third Cliff, a windmill for the *grinding* of corn: the first grinding mill in the colonies and the first of a number of similar mills erected in Scituate. These have long since disappeared. This miller may have taken advantage of the lack of competition, as the court passed the following: "It is enacted that the miller of Scituate shall not take above the twelfth part for the toul of grindinge corne." Gillson was one of a company of men, known as the "Men of Kent," who first settled in Scituate before 1626. They were from Kent, England, of fair means and well educated, forced to leave their native land on account of religious differences. Their abilities and those of their descendants soon made them well known in many lines of work, notably millwrighting, wheelwrighting, shipbuilding, etc., all along the coast from Newport to Maine.

STOCKBRIDGE'S MILL AT SCITUATE, MASS. BUILT AS A SAW MILL IN 1640; MADE INTO A GRIST MILL IN 1650. SHOWS HEXAGONAL GRINDING BOX, CORN FUNNEL AND CRANE WITH SCREW

Isaac Stedman built the first water mill before 1640. This was a sawmill used probably during the flood times of spring and fall only, the windmill being used for grinding corn on account of its more dependable service. This sawmill was erected on a brook in Scituate about 1½ miles from the sea. It was conveyed to a Mr. Stockbridge in 1650, and as he already possessed another sawmill, was converted by him into a grist mill. By this date many people had become what may be termed "forehanded," and did not need to grind their corn in small lots as before and could, therefore, take advantage of the rains which filled the shallow brooks and mill ponds. This mill, which is still standing, has been known since 1650 as the "Stockbridge Mill." The illustration shows the interior as it is today. The timbers are undoubtedly the original construction, but not the boarding. The upper millstone is not the original one, but the nether is said to be the original put in by Stockbridge. The crane and screw used to lift the stones when it was necessary to dress or "pick" them is interesting.

Stockbridge garrison house is but a few rods distant from the mill, and it is owing to this fact that the mill was not burned by King Phillip's men during his memorable war on the colonies. His followers fought a day's battle in attempting its destruction, approaching by the mill race, but were finally repulsed by the settlers who had fled to the garrison house upon their approach. This battle shows that these early mills were of first importance to the settlers and the Indians fully realized this fact, burning as many as they could. One cannot enter such a historic building without wishing to take off his hat to the men who did so much with so little and who showed us of what the true engineer is capable. All glory to them and their work.

In closing, I wish to make mention of the fact that about 1640, due to a split in the first church of Scituate, nearly half of its inhabitants withdrew to Barnstable on Cape Cod, and possibly were responsible for some of the windmills shown by Mr. Redfield.

The dates are those mentioned in the

records, which refer to these mills as already in place; for example, in conveying other property its distance or direction from the mill might be given, thus showing it as already a land mark.

Worcester, Mass. H. P. FAIRFIELD.

The Automobile Torpedo

It would seem advisable to comment upon a statement appearing in the issue of October 14, 1909, being a part of the presentation of the subject of the "Torpedo." It reads: "But perhaps the greatest influence has been upon the development of submarine navigation. The success obtained with this weapon during the last two decades has done more to solve the problem of submarine navigation than all the efforts before its introduction. But for such a masterpiece of man's ingenuity the submarine would probably be in the same condition in which Fulton left it."

I have been on the "inside" of both torpedoes and submarines, and after 15 years fail to note any conditions which would warrant the comparisons above quoted; there being but one point in common in the two types: they are both propelled totally submerged. Strictly speaking, the submarine is the father of the torpedo, and is now its guardian in this special service, in so far as it is a means of bringing the torpedo close enough to the enemy to make it (the torpedo) effective. Therein lies the whole utility of the submarine and the sole excuse for its existence.

It is incorrect to assume that humanly controlled and directed navigation beneath the surface has developed from the results of experiments and tests of the torpedo, although it would appear logical to reason upon those lines. The submarine operates in three different conditions of buoyancy: with a large percentage of its volume above water; with the buoyancy nearly destroyed; entirely submerged. Its radius of action on the surface may be up to 1500 miles; it is intended to navigate submerged for four hours or more. It must assume various trims and attain a predetermined depth; return to the surface, remain there, or submerge again, at will. It must turn through various horizontal angles in all conditions, and be capable of propulsion forward, or its direction reversed. While its speed is not high, compared with surface craft, its very form is a compromise to secure the best results in its several states.

The torpedo has a range of, say, 2000 yards, at a speed of 35 knots or more. Its trip is finished in 1½ minutes, during which period its mechanisms have endeavored to maintain it at a constant depth of submergence and in a straight-line course, for the set distance. Should anything go wrong, at most, the loss is the cost of the torpedo.

In outward appearance there is considerable dissimilarity. The head of the torpedo is blunt for the purpose of pushing the water ahead of the weapon, thereby involving the viscosity of the water as a means of resistance, rather than the greater amount of resultant skin friction over a head of easier lines. The "hole" made by the head is quickly filled by the straight middle body of the torpedo. Such a bow on a submarine would be most inappropriate, except as a braking force tending to retard its speed, excepting in the submerged state. As the submarine's lines are a compromise, and surface speed is essential to efficiency, a form radically different from that of the torpedo was selected.

Means for prevention will not usually serve for the opposite condition. Therefore, the internal equipment of the submarine is not similar to the almost human fixtures found in the torpedo. The word "almost" defines the marked difference between the two. In the torpedo are devices for determining depth, distance, course, etc., in addition to a number of auxiliaries. The weapon has received the attention of the most skilled minds and is in a class by itself for the harrassing problems it presents. However, these devices lack intuition and cannot anticipate, and similar automatics in the submarine are eliminated because of these shortcomings. The human may err, but he has the power of correction; he can think quicker than any combination of metal parts can act; he can forecast and make ready for calls upon his activity, while a device must depend upon actual motion or pressure as it occurs or varies.

For example, pendulum devices have been embodied in trim-regulating systems, invariably with the same results: they are incessantly "hunting," that is, bobbing one way or the other in order to find a state of equilibrium. A master hand can correct trim by knowing his boat and include in his operations such movements as the device must regard singly and in succession.

Most of the fixtures of the submarine have been evolved from those installed in the general run of craft. The tank subdivisions are founded upon the best shipbuilding practice, and valves, etc., are designed on models other than any found in the shops of any industry devoted to the requirements of service ashore. Hull models are the result of evolution, gained by the experience in operative boats. To place them in this state has been one of the material advances due to the internal combustion motor and the electric accumulator and motor. Without these there would be no submarines, although torpedoes might go on forever. In fact, in early designs, the boat itself was the problem in hand, with little attention to the torpedo or its results, except to provide for its carriage and expulsion.

Reliability is the first requirement for submarine apparatus. To place the functions of the submarine under the control of automatics, supplemented by hand devices in case of failure, would mean that the designers appreciated the conditions and have doubled the means. The operating crew will depend on manual adjustments, rather than wait to note failure or success of a mechanical device.

Before inventing for submarines, it is imperative that the designer acquaint himself fully with their operation, mode of attack and equipment in detail. As most of this construction is conducted under more or less secrecy, the last named is one of the hidden mysteries.

New York. F. W. BRADY.

Cutting a Worm Gear without a Hob

Referring to Walter Gribben's comment at page 587, on your editorial footnote to E. S. C.'s article at page 418, entitled, "Cutting a Worm Gear without a Hob," I should like to add a word. If the table is indexed toward the column of the machine a distance equal to the circular pitch of the gear being cut, and a cut taken around the worm gear, the effect will be the same as with a hob.

Tropico, Cal. E. M. DAVIDS.

Examples in Modern Grinding Practice

I have read with much interest H. Darbyshire's article, at page 728, on examples in modern grinding practice, and agree with him in his statement that articles on this subject are frequently lacking in detail. It is the fault of many contributions, on other subjects also, the authors of which are so familiar with their subject that they are prone to overlook the fact that things to them of minor importance —to be taken as a matter of course—are often the ones that are the stumbling blocks to the clear comprehension of the subject by the ordinary mechanic.

Mr. Darbyshire invites critical correspondence on his article, and while I do not wish to criticize, or imply that the article deserves criticism, I would be pleased if he would give a little more information about the "flat ground pebble" that he writes of using to glaze the wheel with so as to get a high finish. I never saw anything of the kind used, and I am at a loss to understand just what is meant by the word "pebble." If it denotes a small stone such as one would pick out of a gravel bank, it would seem to me that in view of the many different properties of which such a stone may be composed much would depend upon getting the right kind of a pebble. I am inclined to think that he means a piece of rock crystal, and

it seems to me that some contrivance would be necessary to hold it against the wheel, as one would suppose that it might soon become too hot to hold in the fingers, especially when used to form a radius on the wheel as he indicates.

Watervliet, N. Y. D. TAPPAN.

A Pulley Repair—Tables of Areas

On page 670 your comment on a "Pulley Repair" is correct as to shrinkage cracks, but the case described was due to a fall and the ends of the arms were not separated. The pulley ran for years and showed no sign of distress.

Some years ago one of the correspondents showed how to increase the usefulness of tables in books of reference, as to squares, cubes, etc., and I have recently had reason to wonder whether use is generally made, with tables of circular areas, of the well known principle that the areas are proportional as the squares of similar dimensions. For instance, diameter = 108¾ inches; table only goes to 100 inches; area of 108¾-inch diameter = 54⅜-inch area × 4.

SAMUEL H. RALSTON.

Norristown, Penn.

The Entropy System for Paying Labor

In a recent issue of the AMERICAN MACHINIST appears an article by Entropy, under the above heading. It specially interested me because, in 1905, while working as a press toolmaker in a certain town in Ohio, a system on somewhat similar lines was proposed to me by the superintendent of the works.

The proposed plan was this: Each man was to be guaranteed the average wage per week, regardless of whether he got his work out on estimated time or not. Of course, as in ordinary conditions, all shirkers and such were to be weeded out; but sometimes unforeseen things would happen, making it impossible to finish a job on time. The guaranteed wage per week was to take care of this. The work was to be dealt out to the men as usual and each man was to hand in an estimate of time he would require to finish the job. The superintendent also was to make an estimate of each job and the two estimates were to be compared and a mean struck between them. Where the difference was great between the two estimates and an agreement couldn't be got at, then the job was to be done at the regular rate per hour.

The idea was, that when a man took a job by contract, he would work harder to get it done, as every hour he was under the estimated time was extra money into his pocket. Suppose a job was estimated at 18 days and the man finished it in 17 days, then he would be paid for 18 days on that contract, while he would actually be working on another contract on the eighteenth day.

The great objection as far as I could see, to this plan and to Entropy's as well, was, that the majority of the men, while first-class workmen, could make no close estimate at all, and when they could, the difference between their estimate and the superintendent's would always be just so much that, when divided up, all chance of finishing a job under time was gone.

While this system, as far as I know, was never tried out, still it shows that others besides Entropy have been thinking along these lines.

Diemaking is a business that can't very well be worked under the premium system, and the most of firms consider payment by the hour as unsatisfactory, so it would seem that some sort of contract system is the way out of the difficulty, if we could only find the toolmakers who could estimate closely.

Jedburg, Scotland. T. H. N.

It is very unusual to find a column or two in the AMERICAN MACHINIST devoted to the funny side of life. A perusal of the article by Entropy would bring smiles to most men whether employees or employers. The problem of getting the most for the least money is one that is being worked out by everyone old enough to have any responsibility.

A foreman or superintendent is supposed to be superior in knowledge and ability to those beneath him. It is not the men, as Entropy suggests, who set the pace, but the employer. A man goes to get a tooth filled and it will cost him a certain amount of money in this country no matter what dentist he employs. The only thing left for him to do is employ the one he thinks best. So, too, with machinists; set a wage which will be an attraction to competent men and then employ those worthy of that wage.

Think for a moment of two machinists bidding for a piece of work with four different pitches of threads. One has a lathe made in 1870 and the other has a quick-change gear lathe. With equal ability it will be easily seen who could bid lower on the cutting of those threads yet through no fault of the employee.

Taking again the same work, would it be to the advantage of the employer to have a man trying those threads with gages to see that they were the proper angle? It would be of no advantage to the machinist to make them anything but the proper angle when paid by the day.

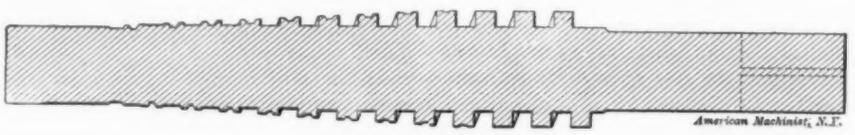
It would indeed be difficult for a man to try to do work by contract when he is not to say the quality of steel used in his tools, nor the class of iron and molders in the molding shop, nor the condition and convenience of his machine. It would be even worse for the employer to have a bearing in need of oil because his contractor was in a tight pinch on his work trying to meet the time limit and hadn't time to fill his oil can; or for his men to break a tap in trying to hurry the work and throwing discretion to the winds. I think for all concerned there is nothing like the standard rate of pay and men.

St. Thomas, Ont. CECIL H. SMITH.

Square Thread Taps

In response to Mr. Groocock's request, at page 333, for experience of others with square-thread taps, I take the liberty to call his attention to an article by myself, published in the AMERICAN MACHINIST of Oct. 1, 1903, under the name of Leroy Taylor.

The problem at that time was to tap steel nuts made from screw stock. The taps were ⅞ inch diameter, 1¼ threads per inch; ⅞ inch diameter, one thread per inch. Both taps were triple thread. The



SQUARE-THREAD TAP

angle, I believe was 15 degrees. The output required was one thousand nuts per day.

I experimented with a set of taps nearly duplicates of those described by M. M. Sharp, and referred to by Mr. Groocock, and found the system too slow. The next step was to make two or three freak taps. They were over twelve inches long at the threaded portion. I endeavored to combine the set in one; this method was a step in the right direction as the tap started easily and cut a good thread but the cost of maintenance was abnormal. The reason for the long taps starting easily was that at the point the thread was nearly a 60-degree V; one point was developed in regard to cutting angles, one was acute and its mate obtuse, the acute side would chip a little, the obtuse side did not cut clean.

The final taps were made with threaded length seven inches, length of pilot one diameter. The taps were threaded straight then turned taper 0.005 above the root of the thread at the point, vanishing four threads from the shank end. A second thread, 60 degrees, was cut with a tool having about 1/32 inch flat on the point,

on the regular thread at about double the taper used to turn the diameter; the cut starting considerable below the root of the regular thread and vanishing five threads from the shank end. The second thread, at the point of the tap, was cut to a depth giving three equal divisions of the regular thread at this point. This gave me an equivalent of a 60-degree thread for starting the tap.

The taps were milled with helical flutes at an angle to the axis that would bring the cutting face at right angles to the helix, that is, with both cutting angles of thread the same. The diameter of the regular thread was relieved very little, just enough to prevent the tap from dragging. The second, or 60-degree thread, was relieved quite generously.

I made the same mistake Mr. Groocock did on one of the earlier taps by relieving the sides of the thread, and with the coarse pitch in proportion to the diameter no amount of skill could induce the tap to cut other than a plain hole. Before the diameter of the tap was relieved it was turned in steps parallel to the axis of the tap. The work was divided for load per tooth, the greatest depth of cut being at the point. The last three threads were full diameter.

A steel nut two inches long could be easily tapped with a 12-inch tap wrench, the nut being held in vise. The taps were used in the regular screw machine, with the nuts held in the usual automatic chuck. I will take a chance in estimating the amount of work done between sharpening of taps by saying it was over 20,000 nuts and the life of one tap over 200,000 nuts.

I judge Mr. Groocock's tap to be more expensive to make and of much shorter life. The load on the corners is increased by removing the corners from alternate teeth. My past experience has shown that the corners are the first part of the taps that come to grief.

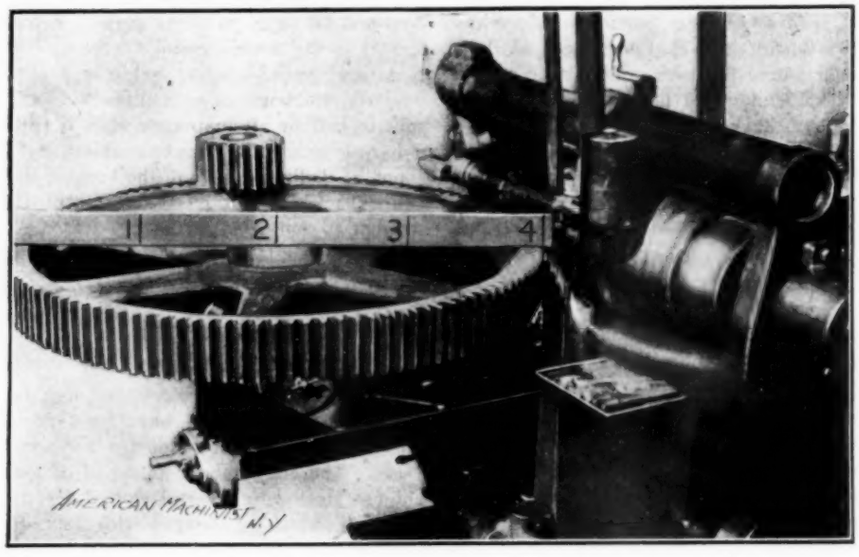
I have made and used square-thread taps, as shown by the sketch, made exactly as described but not on work in as large quantities. I wish to add that the same principle works well when applied to that "nerve racker," square-thread dies.

Philadelphia, Penn. LEROY TABOR.

Cutting a 48-inch Gear on a No. 3 Milling Machine

Some time ago I saw an article in the AMERICAN MACHINIST on cutting large gears on a small milling machine which reminded me of a job we were recently "up against" which was too large to cut by that method.

It is obvious from the illustration how we handled the job, which was a cast-iron gear, 48-inch outside diameter, 5-inch face, 2½ pitch, on the No. 3 Cincinnati universal milling machine shown.



CUTTING A 48-INCH GEAR ON A NO. 3 MILLING MACHINE

O. D. TUTTLE,
Tool room foreman P. R. R. Shops.
Olean, N. Y.

A Shrink Fit Problem

Answering G. J. Lemmens, who, at page 769, requests suggestions regarding the shrinking of rings on tubes, I can say that if the temperature inside of the tube is suddenly raised to, say, 1000 degrees Fahrenheit the scheme will probably be a failure. Inasmuch as there is no perfect metallic union between tube and rings the tube will absorb heat much more rapidly than can be radiated to the rings, consequently the metal in the tube will be compressed owing to the fact that the rings do not heat up and expand harmoniously with the tube, and the tube in cooling will shrink away from the rings.

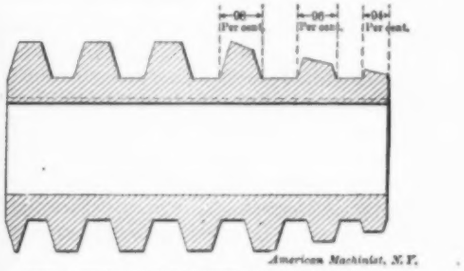
Of course, Mr. Lemmens says "fairly high temperature," which may not cause the tube to expand beyond its elastic limit. As to the allowance and condition of surfaces, if he grinds the outside of the tube and the bore of the rings 0.005 inch will be sufficient. The important feature is to have all rings with the same allowance if more than one ring goes on a tube.

The surfaces must be in good condition (preferably ground) or an unsatisfactory job will result. In any case I would grind the inside of the tube after shrinking the rings on. A stream of water should flow through the tubes while shrinking. There is no apparent reason why they should change their form after cooling. If Mr. Lemmens would say what strains, if any, the tube will be subjected to in service the question could be answered more intelligently.

Scottdale, Penn. M. B. STAUFFER.

A Hobbing Difficulty Overcome

On page 630 mention is made of trouble occurring with taper hobs. Worm wheels have been spoiled due to the taper portion of the hob being dull, thereby distorting the work and machine so that grooves generated during roughing remained after the parallel finishing portion of the hob had passed.



PERCENTAGES OF THINNING HOB TEETH

At the works of the Newark Gear Cutting Machine Company, worm wheels are cut by tangentially fed hobs in which the roughing teeth are thinner than those that finish. On a 1-inch circular pitch thread the first circle for roughing teeth are 0.030 inch thinner than standard; the second 0.020 inch; the third 0.010 inch, leaving 0.005 inch on a side for the full size finishing teeth to cut out.

For any pitch the teeth can be sized in percentages of the normal tooth thickness, as shown by the accompanying sketch. Hobs not so made can easily be corrected. Hobs made this way require about one-third frequency of grinding, a fact which users of helically fluted hobs will appreciate.

We have used this method of thinning the roughing teeth with flytools set in holders, as well as with hobs, for several years.

HENRY J. EBERHARDT.
Newark, N. J.

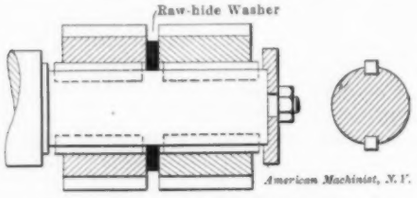
A Water Pail Starting Box

In his article on page 809 entitled, "A Water Pail Starting Box," Mr. Filkins has evidently neglected to state that he placed his bucket upon suitable insulating supports and that he carefully avoided touching it while the switch was closed.

Cleveland, Ohio. B. A. DeMuth.

Machine-cut Double Helical Gears

In the American Machinist, on page 273, bottom of second column, Mr. Day writes: "Built-up, double-helical wheels



ANOTHER METHOD OF KEYING DOUBLE-HELICAL GEARS

can only be used, when the pinions are of sufficient diameter to allow of secure fastening." Now, this statement is not in accordance with the result of my experience, for I have found that *the two halves of pinions for built-up, double-helical gears do not need fastening to each other at all.* In fact, the less you fasten them endwise, the quieter the wheels run and the higher the maximum speed at which they can be run quietly. It is only necessary to let the pinion run in the direction of the arrowhead formed by a tooth of one-half of the pinion with the corresponding tooth of the other half and then the tooth pressure holds the halves together.

It is also advantageous to put a washer of leather or other elastic material between the two halves, so that they cannot only slide together as one piece free on the shaft endwise, as illustrated in Fig. C of Mr. Day's article, but also have a slight *axial freedom of motion relative to each other,* which amounts to exactly the same thing as if they had given in the turning direction.

This is obvious, when one considers that the screw line is obtained by the combination of the simple straight-line motion with the circular motion. If a helical gear is moved a fraction of an inch axially, the effect on the teeth is the same as if they had been rotated through a correspondingly small angle. If the two halves of our double-helical pinion are moved axially *in opposite directions* to each other by means of squeezing the elastic washer more or less hard, we have the same result as if the wheel turned slightly around.

It is, therefore, clear that the give of the two halves of our pinion relative to each other in the end direction amounts in effect to that given in the turning direction, which is so desirable in high-speed gearing and which it is usually so difficult to obtain without using complicated constructions.

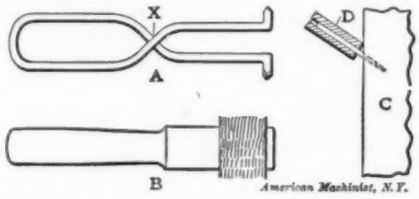
Attic.

Berlin, Germany.

Use and Abuse of Lathe Chucks

F. Reuter's article, on page 565, and R. Charles', on page 841, bring to my mind several things pertinent to the subject. It seems to me F. Reuter has slightly exaggerated the increase in strength due to his method of design. While it is true that the chuck key across the corners is much stiffer in the center the center line of a square from corner to corner is only a mathematical line and the strength or depth rapidly decreases on either side of this line, so that the actual increase in strength would probably only work out to about 10 per cent.

I used to be very particular about my chucks, and the way I took care of them might interest others. The lathe was a 16-inch Hendey. I had two 14-inch independent chucks, one with three jaws, the other with four. Two 9-inch combination chucks, three and four reversible jaws,



THE USE AND ABUSE OF LATHE CHUCKS

respectively, and a 5-inch universal with three reversible jaws. The loose reversible jaws were never used unless absolutely necessary. They were kept in a box in my tool closet and the screw holes in the jaws in the chuck were kept clean by having blind set screws screwed in place. By dispensing with the reversible jaws wherever possible the work was held closer to the line of pressure of the jaw screws. For cleaning the threads in the chucks I had two tools. The one shown at *A* was made of a piece of 3/16-inch drill rod and acted as a sort of two-toothed spring tap or scraper. It scraped the dirt out of the threads very effectively. I crossed the wires as shown at *X* so they supported each other. The other, shown at *B*, was made of wood with a piece of file card tacked around it; it also was very effective in removing dirt from the threads. This brush eventually takes a thread from being screwed into the chuck repeatedly.

Behind the lathe was a wooden post *C*. I cut off some pieces of heavy rubber hose *D*. They were a tight fit on the body of some 5/8-inch lag screws which were screwed into the post at an angle. The heads of the screws had first been cut off and the screws driven home with a pipe wrench. The rubber was long enough to reach past the end of the screw so that there was no chance of injuring the thread of the chuck against the end of the lag screw.

The chucks being up on the post were out of the way of chips and dirt falling from the lathe and they very seldom required cleaning.

New York. E. A. Dixie.

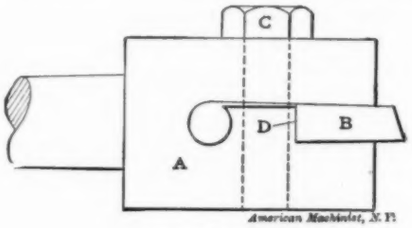
Anent F. Reuter's design of chuck key and editorial footnote to same, on page 565, is this not exposing a greatly neglected detail of shop practice? Some mechanics use the chuck key to remove a jammed chuck, most probably because it is the nearest thing to hand. Others employ the suggested editorial method, viz., a block of wood between back of lathe bed and chuck jaw. Others again, use a bar between two jaws of the chuck, locking the spindle by means of the back gear. Are not all these methods greatly detrimental to the accuracy and life of a self-centering chuck? After having in a particularly stubborn case, a 10-inch chuck split in half by attempting to shift it with a bar, I struck the idea, possibly old to some, of drilling a hole in the boss of the chuck back plate and making a stiff C-spanner to suit.

London, England. Renmos.

An End Mill

On page 669 Pedro illustrates and describes an end mill. I have been using one slightly different in design for some years. The cut shows a holder *A* of machinery steel with the end slotted for the cutter *B*, which is clamped with an ordinary 5/8-inch cap screw *C*.

The cutters I make from high-speed steel blades of cutting-off tools, using the



AN END MILL

top or widest part *D* of the blades as the back when in the holder. I use these up to 2½-inch cutting face on steel and brass.

Hamilton, Ont. MacK.

According to the *Railway Age Gazette* the first experiments with titanium alloy in rail manufacture were made by the Maryland Steel Company in 1907. During the past year the process passed the experimental stage and has been used in a large number of rails.

AMERICAN MACHINIST

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The Prevention of Accidents

The very praiseworthy pamphlet on the prevention of accidents, published by the Fidelity and Casualty Company, of this city, and of which a review notice appeared recently in these columns, opens up an important and promising line of action in connection with a subject which is now attracting a large and deserved amount of attention.

Serious as is our loss by fire, there can be no question that it would be much more serious were it not for the safeguards required by the fire-insurance companies. These requirements are, of course, of a very varied character, beginning with the most drastic—those imposed by the mutual companies, who will not insure a property at all unless it comes up to their high standard and extending down through the stock companies in which the requirements are largely indirect through the basing of the rate on the nature of the risk, although the stock companies also do much in requiring that insured properties come up to certain standards.

There is an almost perfect parallel between the positions of the fire- and of the liability-insurance companies. As in the former case, the procedure was instituted primarily to protect and safeguard the interests of the companies, so in this case the liability-insurance companies would directly protect their own interests by requiring the adoption of appropriate safeguards, and by regulating their rates in accordance with the use of such safeguards, they could bring the same indirect pressure upon the insured that the fire-insurance companies now do and later, if not now, these requirements could be made compulsory.

The liability-insurance companies have, moreover, a kind of incentive toward this action which the fire-insurance companies never had. There can be no question that there is a rising tide of opposition to the liability-insurance companies among the sufferers from industrial accidents, that is, the working people, and in addition to safeguarding their direct pecuniary interests, they can do much to meet this situation by putting the use of safeguards to the front in their insurance program. The seriousness of the situation is not to be minimized. The working people, as shown by their unions, have become thoroughly aroused at the repeated killings and maimings of their numbers, and the casualty insurance companies cannot be too prompt in taking a leading position in this movement for accident prevention.

Liability insurance has assumed large importance, and we believe that in this way more and especially quicker results can be obtained than in any other.

We are glad to note the indication that the Fidelity and Casualty Company is alive to the situation as manifested by the publication of its pamphlet which is but one of several that it has in contemplation, those which are to follow being designed to cover specific industries, whereas this is of a general nature. In the nature of the case, we have no knowledge of its further plans, but we certainly hope that the opportunity which lies before it is manifest to its managers, and that the action already taken is but a forerunner of much more to follow.

Experimental Work and Manufacturing Should be Widely Separated

Many large machine-building plants—in fact, we know of no important exception—maintain a department to work out new ideas and developments. This work is referred to by several names; as, inventing, experimental work, research, development work, and the like. Its successful carrying on is essential to business progress.

When such work is done to the best advantage and with the best results, there is a happy combination of physical equipment and men. The best of machine tools are needed and the most skilful of workmen, together with laboratory appliances suited to the work in hand, and trained investigators to direct it all. The machines must be kept in the finest condition of accurate adjustment and repair and the accompanying attachments and small tools must be kept in constant readiness for use.

The members of the experimental force must be peculiarly adapted for their duties. The workmen must be capable of making a single part for a machine with tool-making accuracy if need be and without the aid of jigs or fixtures or templets. They must be resourceful in rigging up to machine ungainly, awkward castings on the one hand, or to finish the smallest and most delicate pieces on the other. Through it all a boundless amount of patience must be had. Experimental parts are laid out to perform a certain function, not to be easily made. A later stage of a new machine is reached before much thought is exercised to so shape the pieces that the machining operations are simple and adapted to ordinary shop methods. Thus the best of workmen are required for experimental work.

This being true, what is required of the men in charge? To say that they must be trained investigators, conveys no adequate idea of the necessary qualifications. Their knowledge of their own field must be such as to make them recognized experts; at the same time their acquaintance with allied fields, engineering, machinery building and pure science should be far above the average.

They must know the properties of all the materials with which they deal; how to test them; how to work them. Conditions, results, suggestions that the ordinary engineer or mechanic would not notice must be keenly grasped and analyzed for their possible bearing on the solution of the problem in hand. Above all these, men who direct such research and experimental work must have that ability which is characterized as the "creative faculty."

It should be unnecessary to dwell upon the conditions under which the work must be done. Above all things, haste and hurry must be done away with. Sufficient time should be available to study each problem to a finish. The difference between such a course and a half-finished investigation is the difference between success and failure. Distracting conditions, executive pressure, continual interruptions and demands to consider this thing or that cannot be tolerated if experimental and research work is to be done with adequate results.

These conditions in regard to machines, tools, workmen and those in charge are almost diametrically opposed to manufacturing conditions. The shop is intended to work at high pressure, with hustle and bustle. Executive crowding to get out production is necessary and expected. Time is not used to note attendant circumstance possibly leading to new developments, but time must be spent in following prescribed paths to definite production ends. Interruptions and distractions are the order of the shop day for foremen and superintendents. Machine tools are in readiness to do commercial work with commercial accuracy, with special tools galore; not the refined work of tool making without any special tools whatever. Could two conditions of shop work as regards both men and machines be more different in their essentials?

Yet, where do we find the average shop experimental department? In some corner of a manufacturing department, at best separated only by a board partition.

The equipment of machine tools may be of the best, but the manufacturing force is constantly trying to borrow this machine or that for "just a little while, we are crowded to death." They do not ask for the testing machines, etc., simply because they cannot use them. But this feature is of small moment compared with the demands upon the members of the inventing or experimental department. Very often such men have reached their positions through the manufacturing departments, and are expected to act as manufacturing experts as well as do creative work.

One minute an intricate problem in design, or method, or process is under consideration; the next a batch of spoiled pieces is in hand with the query, "will they go?" At 11:15 a.m., the operation of a new machine, that has just been started after six months of hard work in designing and building, is being watched with tremendous intensity when a boy rushes up with, "Mr. So-and-So wants you immediately to straighten out about those set screws to ship this noon, sure!"

Experimental work should be widely separated from the manufacturing. There should be no mixing or borrowing of machines and tools, no demands upon the experimental men by the manufacturing end. Preferably, these two parts of a business should be in separate buildings, and it is not altogether certain that they should not be in different towns. A sane development is illustrated by our article on page 437, describing the research laboratories of several German manufacturing firms. We know of no similar development connected with any machine-building firm in the United States.

The need of freeing the inventing and experimental work from the demands of production is more insistent as business activity increases. The need is, therefore, most real at the present time.

New Publications

THE ELEMENTS OF MACHINE DESIGN, PART I. By W. Cawthorne Unwin. 525 5¼x8¼-inch pages; 387 illustrations; indexed. Longmans, Green & Co., New York City. Price, $2.50.

Professor Unwin's treatise on machine design needs no introduction to any English-reading mechanical engineer. The first edition was published in 1877. In 1890 the work was thoroughly revised and enlarged. It was again revised and enlarged in 1901, and the present edition, instead of being a revision merely, has been largely rewritten without, however, any material alteration in plan or scope. The author's aim has been, as stated in his own words, "To gather together from science and practical experience the materials for critical examination and the problems which arise in machine designing, and, within such limitations as a short treatise permitted to exemplify the process of criticism, applied to the problems most frequently presented, whether in applying the formulas of mechanics or in following precedents." The essential elements of accuracy, clearness of expression and usefulness that have made Unwin's "Machine Design" a standard textbook for the past 20 years or more are preserved in this last edition. Much of the material is new. In fact, there are many references to papers presented to engineering societies and in the technical press that have appeared during the last two years. In the treatment of standards, American practice is given equal prominence to the practice of Great Britain, as is shown by a consideration of Chapter 5 on screw threads and bolts. In Chapter 12 on tooth gearing more prominence is given to the cycloidal form of tooth than seems necessary when considered from a viewpoint of American practice. Yet these references but tend to show that no important element of machine design has been overlooked in this admirable treatise. Chapter 4 on riveted joints is as complete a discussion of the subject as we have seen in the space of a few pages. Should we be inclined to indicate any one chapter that seems inadequate in the treatment of its subject, it would be Chapter 1 on Materials Used in Machine Construction. Here the newer alloy steels so prominent in automobile manufacture are not treated of with the single exception of nickel steel on page 17. The chapter headings are: Materials Used in Machine Construction; On the Straining Actions to which Machines are Subjected; Resistance of Structures to Different Kinds of Straining Action; On Fastenings—Riveted Joints; On Fastenings—Screw Threads and Bolts; Keys and Cotters; Journals, Crank Pins, Pivot and Collar Bearings; Axles and Shafts; Shaft Couplings; Bearings for Rotating Pieces; Rolling Contact—Friction and Wedge Gearing; Sliding Contact—Tooth Gearing; Helical and Screw Gearing; Belt Gearing; Rope Gearing; Wire Rope and Telodynamic Transmission; Chains and Gearing Chains.

In closing, no progressive machine designer or engineer can afford to be without this book in his working library.

A Deparature in the Training of Teachers in Industrial Education

The demand for competent teachers of industrial arts has led Teachers' College, Columbia University, to plan a series of night courses, by which young men who have a first-rate technical ability in the trades, such as woodworking or machine-shop work, can prepare themselves for the profession of teaching. These courses are being offered at night in the School of Industrial Arts of Teachers' College, and cover mathematics, drafting, design, woodworking, machine-shop work, industrial chemistry, industrial history, methods of teaching industrial arts. A three years' course of night work will enable an expert mechanic, otherwise qualified, to gain a diploma as teacher of industrial arts.

A summary of railway accidents in the United States during the three months ending June 30, 1909, shows the number of persons killed in train accidents was 99 and those injured 2116. In the total number of passengers and employees killed in train accidents, the present record is the lowest that the quarterly bulletins of the Interstate Commerce Commission have ever shown.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make it Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

A Universal Tool Holding Head

The Brown & Sharpe Manufacturing Company, Providence, R. I., has recently brought out a universal head for use upon all of their universal grinding machines, and also upon their No. 13 universal and tool grinder so that reamers, milling cutters, counterbores, drills, and a large variety of other cutting tools commonly used in the machine shop, can in many shops which hardly need a special tool grinder be quickly and accurately sharpened.

Its chief feature is a swiveling vertical column, carrying a swivel head for supporting the work to be ground. The vertical column has a large bearing where it is mounted on the base plate, which is fastened to the table by a clamping bolt at each end. It can be turned through a complete circle. The base is made in two styles, one having a tongue to fit the T-slot in the table of universal machines; the other a longitudinal V-way that fits on the table of the No. 13 universal and tool grinding machine. In either case the alinement of the head with the table is correctly and simply maintained.

FIG. 1. UNIVERSAL TOOL-HOLDING HEAD FOR GRINDER AND EQUIPMENT

The head swivels in a vertical plane and may be clamped at any angle to 90 degrees, either side of zero, its position being indicated by a dial graduated to degrees on the circumference of the base. The clamping bolts pass through circular slots in the head casting and vertical slots in that of the column. There is a vertical adjustment of 4 inches which is controlled by means of a ball crank at the top of the elevating screw. With the head at its extreme hight, work up to 16 inches in diameter will swing over the table; by turning the head at right angles, light work up to 24 inches in diameter can be accommodated.

Two methods of holding work are provided; milling cutters being clamped directly by their shanks or arbors in a V-shaped vise, while work requiring sliding shells is supported on a rod known as the cutter bar.

The cutter bar is made of steel, ¾ inch in diameter, and has a flat side for clamping screws to seat upon without injuring the working surface. It is supported in bearings in the work head casting and, in addition to holding work to be ground, serves as an arbor for the upper portion of the vise to pivot upon. It can be adjusted to any length and clamped by means of set screws. An additional cutter bar ⅜ inch in diameter can be furnished when so desired.

The vise is rigid and readily adaptable to many varieties of work. The lower jaw consists of a heavy V-shaped trough in which the shank or arbor of the work is placed. The upper jaw pivots and is adjusted by means of a hand clamp screw. A long drop back rest is carried by the upper jaw. To fasten work, this rest is lowered until it touches the piece and is clamped in this position. Then, by simply adjusting the hand clamp wheel the drop back rest is securely fastened upon the piece.

An adjustable center rod is provided for supporting and taking the end thrust of work having a tapered shank; it may also be used for taking the end thrust of centered pieces that are not clamped solidly in the vise while grinding.

A device known as a taper shank mill sleeve is furnished with the universal head and is particularly useful in grinding work having taper shanks, such as end mills, etc. It consists of an outer sleeve that can be rigidly clamped in the vise, and a taper bushing in which the work is held. The bushing is free to run in the

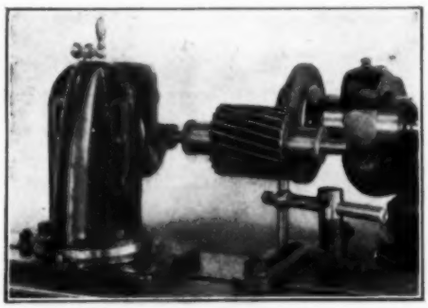


FIG. 2. SPIRAL MILLING CUTTER ON CUTTER BAR

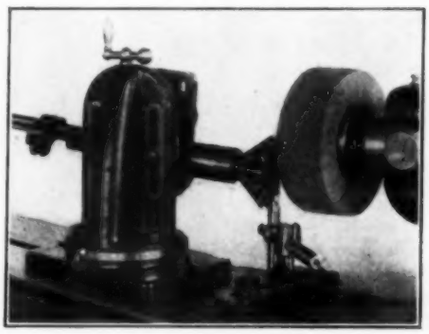


FIG. 3. ANGULAR CUTTER SUPPORTED IN THE VISE

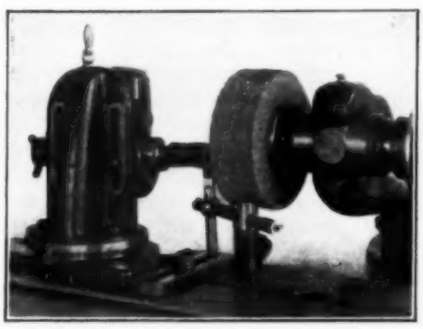
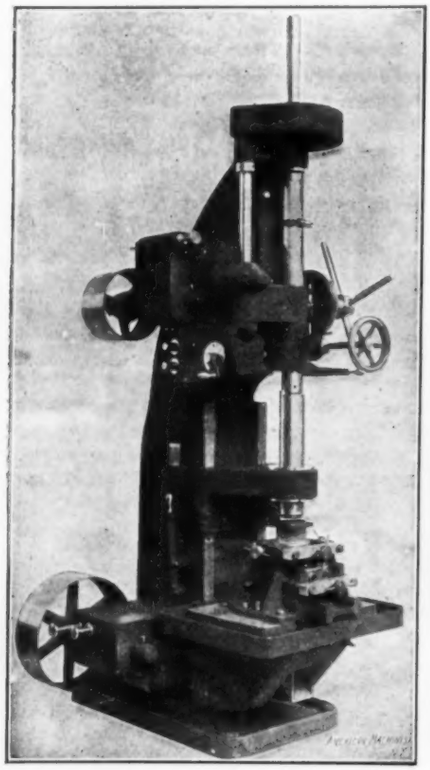


FIG. 4. SHOWING USE OF TAPER SHANK SLEEVE

sleeve, but is held positively against the end by a spring. A handle fastened to the outer end of the bushing serves to hold the work against the tooth rest as well as for indexing. Two taper bushings are furnished, one No. 7 and the other No. 9.

Cylinder Boring Machine

The accompanying illustration shows a machine for boring automobile cylinders



CYLINDER-BORING MACHINE

that has been added to their line by Baker Brothers, Toledo, Ohio.

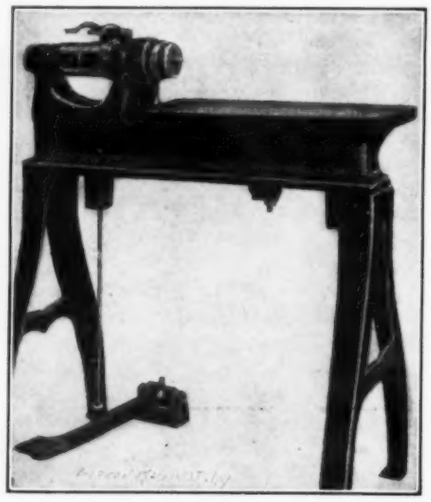
This machine is designed for boring short cylinders and similar work and is rated to bore 3¼ inches in diameter by 8 inches long. While this is the diameter to which the machine is best suited for maximum production, it will easily bore much larger diameters as it has a large power factor. The machine is adapted to boring single cylinders, twin cylinders or four cylinders cast in block. The method of handling the work is such that the cylinders may progress from one spindle to the next without interruption for rough boring, straighten boring and reaming; or they may be laid aside for seasoning between any of the operations. It is customary to set these machines up in gangs of three or four units. Where cylinders are reamed, they are roughed under the first spindle, straightened under the second and reamed under the third. When but two cuts are taken before grinding, they are roughed in the first and third spindles and straightened in the second and fourth.

The machines are also built with special attachment for boring, facing and tapping seats in automobile cylinders, either two or four tools being carried by each spindle.

Eight speeds can be obtained quickly by means of sliding-gear changes. Twelve changes of geared feeds are provided. The machine has a swing of 12 inches from center of spindle to frame; has a single belt drive and weighs 3500 pounds.

Polishing and Finishing Lathe

This machine is designed for doing polishing, burring, etc., and all kinds of light work where pieces can be held in a spring



POLISHING AND FINISHING LATHE

or collet chuck. The chuck is opened by the foot lever which simultaneously shifts the belt to the loose pulley, applying a friction brake to stop the machine immediately. Releasing the pressure on the foot lever shifts the belt back again and closes the chuck, thus leaving both hands of the operator free. The machine weighs 325 pounds, has a bed length of 42 inches, and a swing over bed of 11 inches.

It is manufactured by the F. E. Wells & Son Company, Greenfield, Mass.

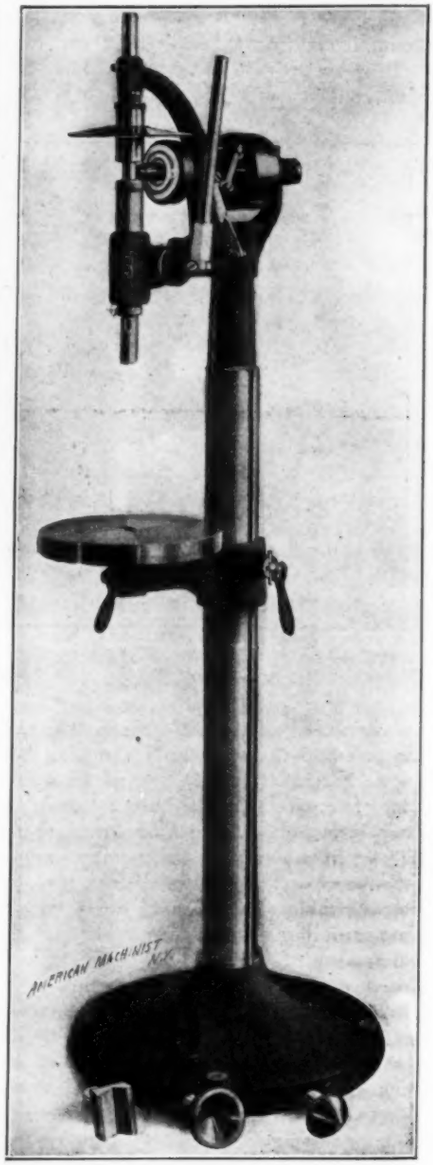
Quick Change Speed Drill

The interesting features of this 14-inch sensitive quick-change speed drill are contained in the speed mechanism, the automatic stop and starting device, and the keyway in the column and key lock, by which the table can be kept central with the spindle on any point of the column.

The speed-changing device is composed of a shifting driving wheel which operates to and from the center of a friction disk. Levers connected to the feed lever operate the driving wheel in a manner that permits the operator to change the spindle speed by slightly moving the feed lever. Thus the operator is enabled to instantly increase or diminish the spindle speed without any other adjustments. The driving wheel is of leather fiber clamped between two disks. The friction disk is heavily counterbalanced by means of a coil spring which prevents slippage and loss of power.

The spindle mechanism is such that when the feed lever is raised to a standing position the spindle automatically stops. The drill thus only runs when actually drilling. The spindle is made of high-grade carbon steel and runs in bronze bearings.

The drill is made by the Villinger Manufacturing Company, Williamsport, Penn.



QUICK-CHANGE SPEED DRILL

Floating Reamer Holder for Vertical Mills

This floating reamer holder takes any make or style of reamer, whether solid or shell, adjustable or non-adjustable, having a Morse taper shank and can be used on any make or style of vertical boring mill having a turret with flat sides.

Nearly all users of chucking machinery appreciate the advantage of using a floating reamer on the final finishing of the work before removing it from the machine, as when a reamer is held rigidly in position it is liable to produce a taper hole or ream the hole too large. With a machine, like a boring mill for instance, having a turret with a cross movement the floating reamer is indispensable.

Unless special care be exercised the operator does not bring the turret back to exactly the same position every time, even with a positive stop. The pressure of the hand on the crank handle is very likely to vary enough to change the exact alinement of turret and spindle a few thousandths of an inch, causing the hole to be taper or enlarged to a greater or less degree.

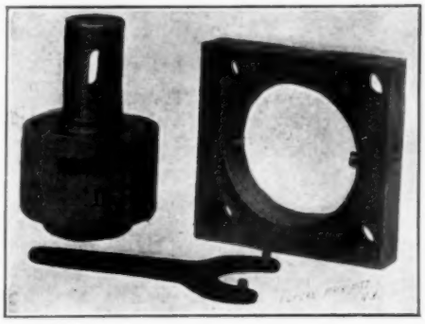


FIG. 1. FLOATING REAMER HOLDER

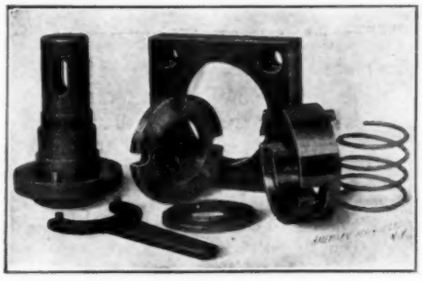


FIG. 2. CONSTRUCTION OF THE HOLDER

Figs. 1 and 2 show the holder assembled and in detail while its operation is seen in Fig. 3. Plate *A* is made to fit the face of the turret on any size or make of boring mill, and is fastened to same by four fillister-head screws. Sleeve *C* is held in plate *A* by means of two steel pins *B* which are tight in plate *A* and made to fit freely in bayonet grooves *D*. Reamer holder *E* floats on sleeve *C*, the floating motion being obtained through the four

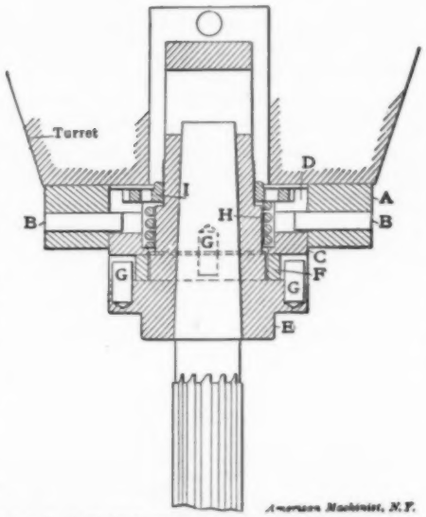


FIG. 3. DETAILS OF FLOATING REAMER HOLDER

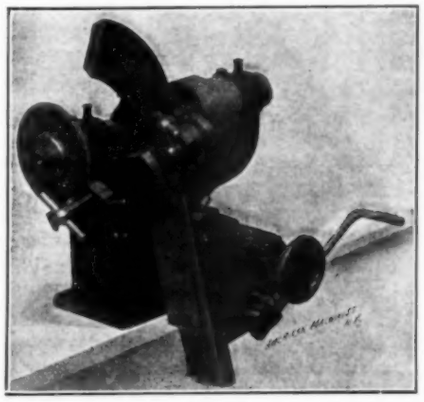
steel pins *G* extending into driving ring *F*. Two of the pins are tight in the holder *E* and two in sleeve *C*. The faces of sleeve *C*, driving ring *F*, and reamer holder *E* are held tight against each other by means of spring *H* which insures the reamer being held perfectly true. Spring *H* is adjusted by means of nut *I* which is turned with a spanner wrench furnished with each holder.

It will be seen that plate *A* is the only part of the device that has to be made special to fit different makes of boring mills. The manufacturers, the Colburn Machine Tool Company, Franklin, Penn., are prepared to furnish these holders with plate to fit any make of vertical turret head mill.

They are made in two sizes, No. 1 holding reamers up to 3 inches and the No. 2 up to 4 inches in diameter.

Die Sharpener

This machine was designed for grinding scientifically and rapidly bolt cutters and practically all forms of threading dies. It is furnished with a 6-inch grinding wheel which is suitable for grinding all sizes of dies. The spindle runs in taper bronze bearings and suitable graduations on the slide enable the machine to be easily set and adjusted.



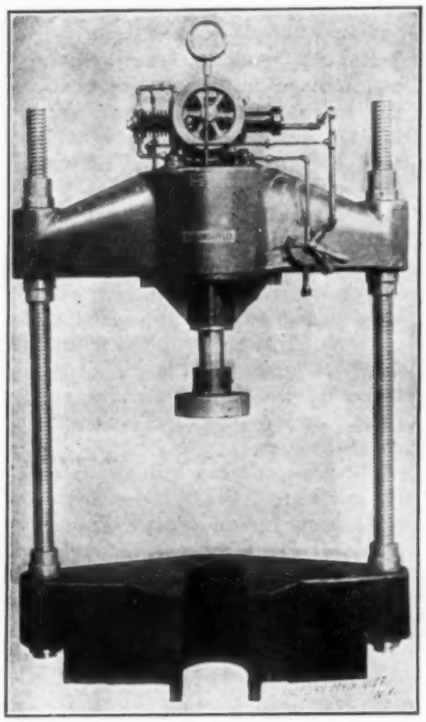
DIE SHARPENER

The sharpener grinds bolt cutters and all dies of a set to uniform depth and gives them correct entrance on throat with proper clearance, thus distributing the cutting equally among the four dies. The grinding operation only takes off a minimum of metal.

The machine is 56 inches high, weighs 250 pounds and has a countershaft speed of 500 revolutions per minute. It is manufactured by the National Machinery Company, Tiffin, Ohio.

Improved Pneumatic Press

This press consists of two main-frame castings held together by massive screws on either side. The base is very heavy and permits a large wheel to be placed centrally between the screws. The opening shown in the lower base permits any work, such as a spindle being driven downward, and has the advantage over the plain circular opening in that the work does not have to be lifted high in the air and then dropped into the hole, but merely has to be lifted to a normal hight, such as that of a bench, and then pushed into place. This may be fairly illustrated by the problem of driving a lathe spindle into the faceplate.



IMPROVED PNEUMATIC PRESS

The upper frame is also very heavy, and contains in itself a cylinder from which the power is derived. This piston is of a peculiar construction, which has been found to be necessary when holding an air pressure of 225 pounds. The lower piston

rod carries a heavy shoe which is faced on the bottom with babbitt, so that the work under pressure will not be in any manner injured. The two upright screws on the sides carry the upper frame by means of the nuts shown above. These nuts are adjustable, so that the upper frame may be either raised or lowered to meet whatever conditions may be imposed upon the press. Above the cylinder there is mounted an automatic pump, whose function is to increase the pressure three times above the initial air pressure. It is heavily constructed and produces a downward pressure of 20 tons. A dial or air gage is furnished in order that the operator may at all times know exactly what pressure is being applied to the work.

The machine is made by the Springfield Machine Tool Company, Springfield, Ohio.

The Acme Turret Lathe

The new machine shown herewith has been brought out to meet requirements of the modern conditions imposed by the use of high-speed steels. The head is cast solid with the bed and provided with a three-step cone for a 3½-inch belt on the 2¼-inch machine, has friction back gears, and so arranged that the central position of the operating lever stops the spindle. The bearings are babbitt, ring oiled and large enough to stand up under the heaviest work. The end thrust is taken by the front bearing to avoid any binding due to the difference in expansion between the spindle and the head. The chip pan is unusually deep.

The automatic chuck is forged solid on the end of the spindle, reducing the overhang from front bearing and supporting the collet to its extreme end. A master collet is furnished with each machine, also one set of bushings to take stock of the largest capacity of the machine. The chuck and stock-feeding lever, as well as the other levers, are placed so they can be reached by the operator without changing his position.

The turret is hexagonal, and has tapped holes for attaching tools to the face, in addition to the regular holes with binder bushings. A hole the same size as holes in the turret is bored through the turret stem, thus allowing long work to be turned with short, stiff tools. The tool clearance over the top of the slide is made extra large to permit the use of large dies and turret tools. The turret slide is made wide to give extra rigidity to the turret and tools. Independent adjustable stops are provided for each hole in the turret; the abutment of stops can be shifted to allow a slight further movement of any tool beyond the stop when desired, without disturbing the adjustment of the stops.

The power feed is of the geared type, giving four changes instantly obtainable by the movement of a lever placed directly over the rear spindle bearing.

Some interesting details of the turret are shown in Fig. 2. Under the taper bushing for the locking pin is a tapped washer *I*, by which the bushing can be readily removed. The lock-bolt lever is controlled by the tumbler *B*. As the turret slide is drawn back the incline shown draws out the lock bolt, and as soon as the turret is turned the roller on the lock bolt drops behind the tumbler. As the turret slide is moved forward, the tumbler swings with the locking bolt, as shown by the dotted lines, but drops back to its unlocking position ready for the next return of the slide. The feed stops are also shown at the back.

The cut-off is provided with a large graduated dial and positive stops for the cross-slide; also hand longitudinal adjustment by means of handwheel and screw, with bronze nut on front cap. The screw is completely protected from chips and dirt by means of two steel tubes fastened to the nut. The cut-off is also supplied with power cross-feed when desired.

The machine is so arranged that power feed to turret, power feed cut-off, etc., can be attached at any time without additional work. The stock feed can also be attached at any time to machines with automatic chuck, without altering the spindle.

Fig. 3 shows the countershaft clutch. *A* is the shaft; *B*, the driving sleeve, which is keyed to the shaft; *C*, the friction, which is connected to the shaft by drivers *G*; bearing sleeve *D* is a sliding fit in pulley hub *E*, and runs on driving sleeve *B*, and is provided with large oil chamber, holding enough oil to run a month or more without refilling. By loosening *H*, pulley *E* can be adjusted to compensate for wear. This is made by the Acme Machine Tool Company, Cincinnati, O.

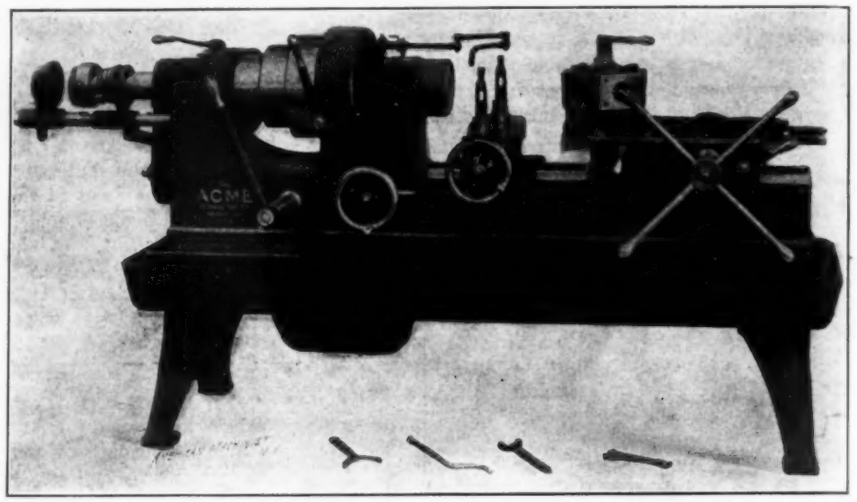


FIG. 1. THE ACME TURRET AND SCREW MACHINE

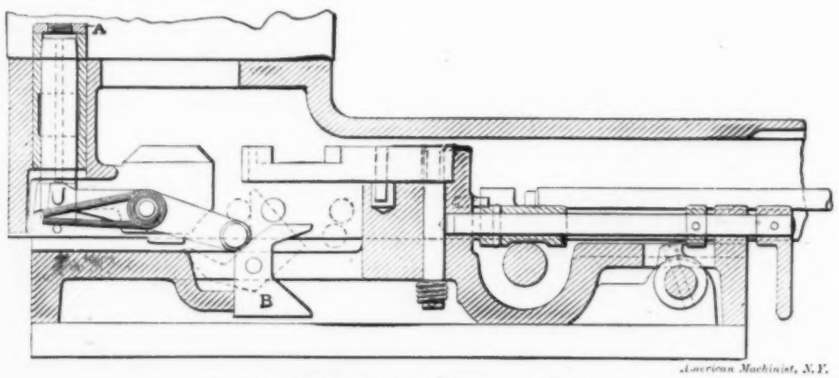


FIG. 2. DETAILS OF THE TURRET MECHANISM

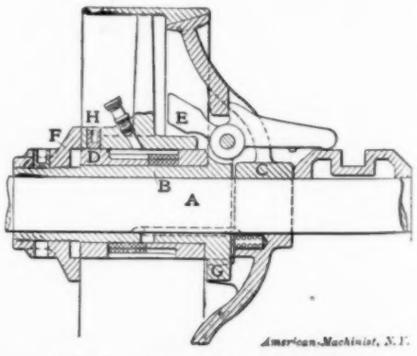


FIG. 3. COUNTERSHAFT FRICTION

New Features in Chuck Construction

Although the general appearance of this chuck is not materially different from others, a glance at the details will show a general strengthening of the jaws and screws to meet the heavier duties imposed by the use of high-speed steel and high-powered machines.

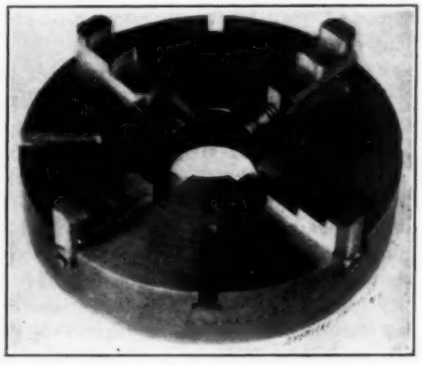


FIG. 1. THE S. E. HORTON CHUCK

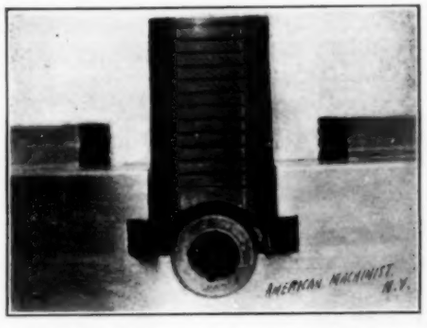


FIG. 2. THE JAW AND SCREW BEARING

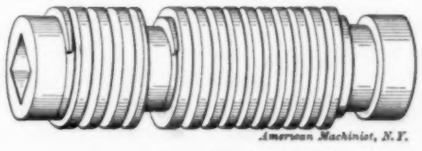


FIG. 3. THE CHUCK SCREW

The screw has no bearing on the threads, but on the three turned bearings shown, distributing the thrust and supporting the screw under the jaw at all times. Then too, the outer bearing is simply a support and not a thrust bearing, which avoids breaking out the rim under a heavy strain.

The jaws are held in the body by a very broad bearing, as can be seen by the end view, which presents a long resistance arm to the bending strain tending to twist the jaw out of the body. This allows the large-diameter screw to be placed very near the face of the chuck and gives it a half bearing in the jaw.

Special attention has been given to the chuck wrench, with the idea of making it sufficiently strong and with leverage enough to avoid the necessity of hunting up a piece of pipe to slip over the end. These are made in sizes from 8 to 26 inches by the S. E. Horton Machine Company, Windsor Locks, Conn.

New Features In Sensitive Drill Design

Even a casual examination of the machine illustrated herewith will show several new features in sensitive drilling machines. Perhaps the most striking of these is the belt-tension device, best seen in Fig. 2. Back of the main column is an open knee in the form of a triangle which supports the upper driving cone and the spindle driving pulley. These pulleys are journaled in a floating frame having the jack screw in the lower end, this in turn having a ball end to allow free play at any angle. This floating frame is guided vertically by the knee and clamped between its two sides in any desired position. Loosening this clamp and adjusting the jack screw gives any desired tension and also equalizes this tension between the vertical and horizontal belts. It is then clamped to maintain this tension.

The spindle has a 5-inch travel and a No. 2 Morse taper. The driving pulley is between two bearings. The stop is on the quill rather than the spindle itself, and either a micrometer depth gage, as shown, with a substantial buttress thread, or a plain gage, is furnished. Ball thrusts are fitted to all spindles, and either plain or ball bearings supplied for the other bearings. The plain bearing machines have die-cast bushings of Parsons white bronze, which can be readily renewed, and are fitted with ring oilers.

The feed handle fits in a ratchet head so that by turning it a trifle the pawl or clutch finger lifts and can be moved to a more convenient position by the handle itself, without interfering with the drilling in any way. The handle can also be pushed through the head to give more or less leverage according to the drill being used.

The table is 14x44 inches on the four-spindle machine, and is substantially ribbed after the fashion of a surface plate to insure stiffness when heavy jigs are used. It has a movement of 12 inches by the screw shown, which has a ball thrust and requires no hole in the floor. The heads have a movement of 11 inches on the column. The belt can be shifted by pedal at either side of the column. All clamping screws have handles so that wrenches are unnecessary. They are built with from one to four spindles by W. H. Leland & Co., Worcester, Mass.

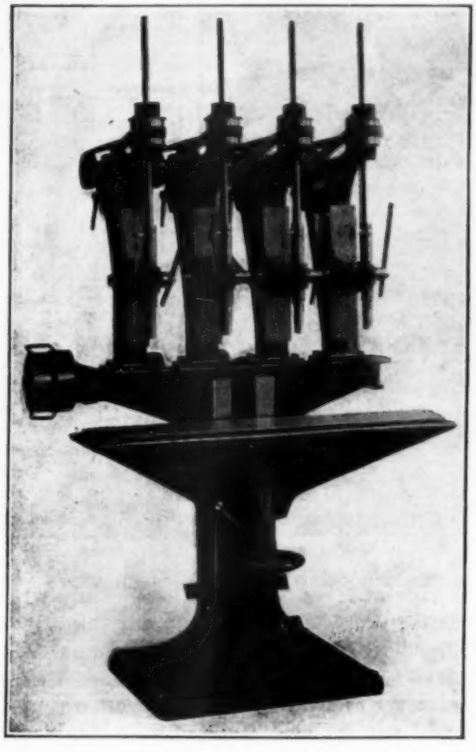


FIG. 1. FOUR-SPINDLE LELAND DRILL

FIG. 2. REAR VIEW SHOWING BELT TIGHTENER

A Hack-saw Which Uses the Full Blade at All Times

The hacksaw shown in the accompanying illustration has several features which are decidedly out of the ordinary. Perhaps the most important one is the device whereby the whole length of the saw blade is used at all times regardless of the size

of the material being cut. This is accomplished by the connections with the rear vise jaw which adjusts the stroke of the saw in accordance with the size of the work. As shown, the saw travels practically its full length, and as the jaws are opened to hold a larger piece, the stroke is automatically shortened, so that the full length of the blade is just utilized in every case.

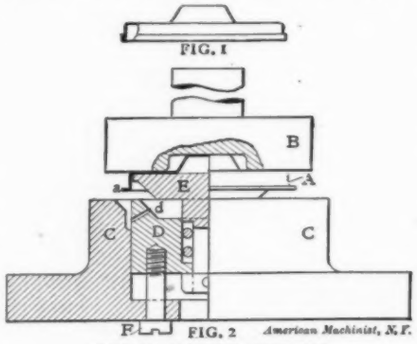
The change of stroke is accomplished by a quill having a spiral groove moving the crank pin along the slide of the driving gear, shown at the front of the machine. This gearing also gives a quick return motion, owing to the crank pin being on the lower portion of its travel during the return stroke and thereby acting on a shorter leverage on the arm which drives the saw frames.

The saw-frame guide is held very rigidly by the brace carrying the weight which obviates side play and vibration. The saw is lifted on the back stroke by an expanding clutch at the end of the guide, which has a sufficiently large bearing to grip positively and release quickly at the end of the stroke. A knock-off is provided

Press Tool for Turning Flanges

By Walter G. Groocock

The brass cap shown in Fig. 1 was required in various sizes and large quantities, and was produced in the form shown at *A*, Fig. 2, by means of an ordinary compound press tool. After the first operation the caps were put in a spinning lathe and the flange *a*, Fig. 2, doubled back. This method was satisfactory until the speed microbe visited the shop and decided that they should be done cheaper.



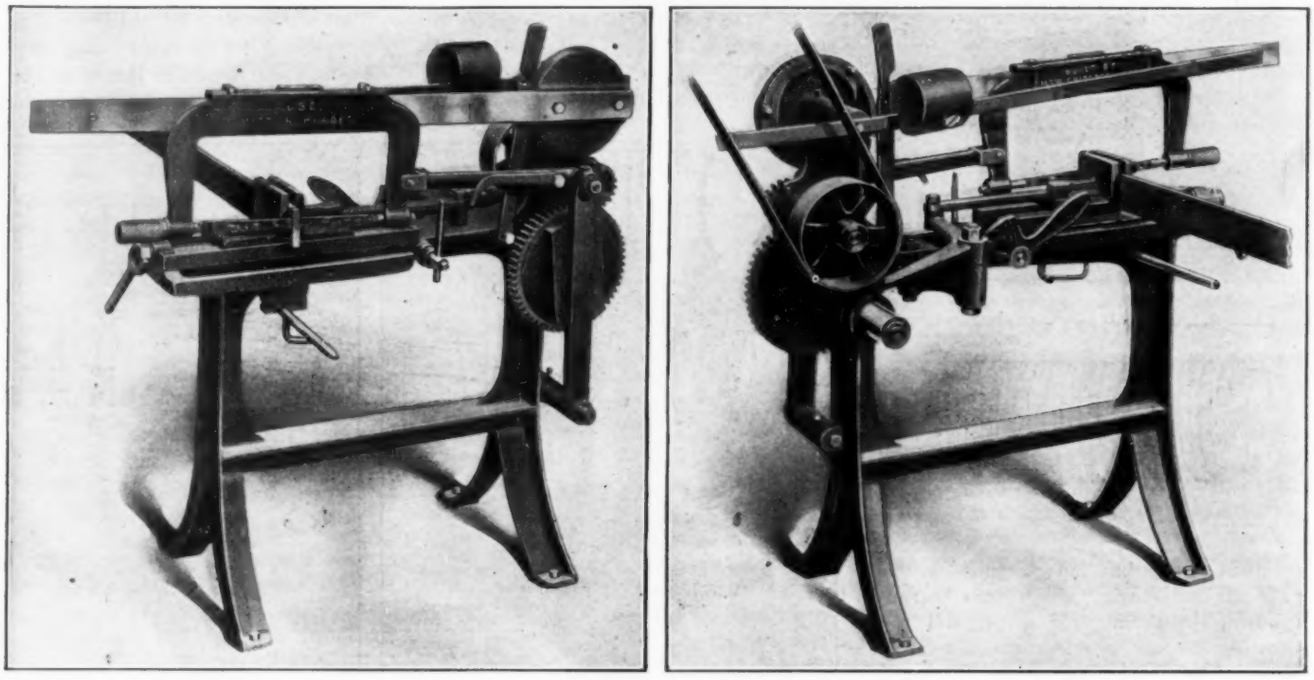
THE WORK AND THE DIE

E is secured in *D* by means of a collar and taper pin riveted over, the stripping agent being a spiral spring. *D* is held in *C* by means of three screws *F*, one of which is shown. The heads of these screws come in contact with a pressure plate and thus force *D* to strip the finished cap from *C* and then *E* strips it from *D*.

The stripper *E* is made small in diameter so that when the work is stripped off *D*, the press being inclined, a flick with a piece of wood by the operator throws the cup off.

Owing to the hole in the bottom of the tool the pressure plates and pad, not shown, were held in a cage.

To insure easy stripping air holes are often a necessity. Such a hole is shown at *d*, the action of the tool in turning over the flange makes the cap an air-tight fit on *D*, and without an air hole the suction necessitates a strong spring. This in its turn requires the pad to be screwed up hard to insure *E* closing on to *D* before *D* commences to descend. This strengthening of the spring and screwing up of the pad means more power to drive the press, all round work little fitting is required.



A NEW HACK-SAW BY THE MASSACHUSETTS SAW WORKS

so that the machine stops automatically when through the cut, or at any predetermined depth of cut.

The length gage is shown swung out of place, and the machine is stopped and started by the small handle in front of the bell crank in the second view. No wrenches are required, as all adjusting screws and nuts have fixed handles. This machine is the result of the experience of the Massachusetts Saw Works, Chicopee, Mass.

Fig. 2 shows a tool designed and made by me for doubling the flange back in the press, which knocked five-sixths of the spinning price off.

The tool consists essentially of four pieces: *B* the top tool, which was made large enough to do for several sizes; *C* the bottom tool, or bolster, fitting a standard holder; *D*, the inner plunger and *E* the stripper.

It will be seen from the cut that the tool can be made on the lathe, and as it is consequently is undesirable. The tool was made of mild steel, but case-hardened on the working faces to resist wear.

Another point that should be noted in this class of tool—never take it for granted that the thickness of, say, the flange at *a*, Fig. 2, is the same as the plate it was made from. As there is sure to be some thickening of the material, the cap itself should be gaged to get the dimensions for boring, so as to keep the flange close and yet not stick in the tool.

Tenth Annual Meeting of the National Civic Federation

Employers' liability, employees' compensation, wage-earners' insurance, old-age pensions and the prevention of industrial accidents—in fact, all phases of the questions relating to the compensating of workmen for the loss of life, limb or health in the pursuit of modern industry were discussed at the tenth annual meeting of the National Civic Federation held at the Hotel Astor, New York City, November 22 and 23. The large attendance, the great number of speakers from all walks of life, employers, employees, men of affairs, men in the public service, an attendance of over 800 at the closing banquet indicate the great interest taken in such subjects, not only by the membership of the Federation, but also by the general public.

The president, Seth Low, in his opening address, laid particular emphasis upon the fact that the maintaining of the wage scale in industry had had a tremendous influence in aiding the quick recuperation of business from the panic conditions of the past two years. Both capital and labor he believes, had been spared losses formerly incidental to regaining the standard of wages after a reduction due to business conditions, and after these conditions had passed away.

Workmen's Compensation in England

A. H. Gill, member of parliament and secretary of the Operatives' Cotton Spinners' Association of Bolton, Eng., discussed, "Workmen's Compensation Act in England. Is It Just to Labor?" He asserted that there are 3800 fatal accidents in England per year. Under the operation of the compensation act the workman's family is given a lump sum compensation equal to three years' earnings, provided, however, that the annual sum must not be more than £300 ($1500). A judge decides how this sum shall be determined and apportioned. A noticeable feature in the workings of the act is the small amount of litigation. Ninety-nine per cent. of the awards have been made without trouble. In the event of an injury to an apprentice it was the purpose not only to give him a share of his earnings at the time of the accident, as liability, but to make some provision on the ground of his future prospects.

In especially unhealthy occupations, such as lead working, dyeing and the like, where the operatives are susceptible to certain vocational diseases, these cases are placed in a special category, and employees so stricken are subjects for care by their employers. In briefly summing up the act Mr. Gill said: "The act has been good in that it has provided help to the injured, but it has gone farther than that and is reaching its primary object which was the prevention of accident. Machinery is better guarded and new machinery is so constructed that these accidents are less likely to occur. There has been a great change in this regard. The opinion in England is that the employer should stand the cost."

Major E. E. Pirokowski, representing the Krupp Works of Essen, Germany, in discussing "Workmen's Insurance in the German Empire," said that in 1906 there were paid in sick benefits 265,000,000 marks ($53,000,000), in the same year there were paid in accident benefits 145,000,000 marks ($29,000,000). Yet in spite of all this wonderful work individual employers are doing a great deal for their employees that is entirely outside of statutory requirements, and for such purposes they are annually contributing large sums of money.

George M. Gillette, of the Minneapolis Steel and Machinery Company, in a lengthy paper, "Compensation for Victims in Industrial Accidents—The Employers' Viewpoint," arraigned the present conditions in these words: "I would bring the existing system before the bar of public opinion, and charge it first, with disturbing relations between employer and employee; second, with breeding perjury; third, with failure to prevent or decrease accidents; fourth, with uncertainty; fifth, with inhumanity and, sixth, with abuse.

"There is no more fruitful cause of disturbing relations between employee and employer than modern damage suits.

"In the last five years the employers' liabiiity companies collected from the employers they insured $95,633,362, while the amount they paid to workmen was $44,968,633. That is, 53 per cent. of these funds has gone to soliciters and in administering the companies. Moreover, of the amount paid in compensation, about 40 per cent. has been swallowed up in litigation, so that only about 25 or 30 per cent. has found its way to the relief of the injured or his family."

Tuesday Session

The session was opened by a paper from George W. Perkins, "The Underlying Principle of the Profit Sharing, Benefit and Pension Plan of the International Harvester Company." These plans cover the following: First, Profit Sharing; second, Industrial Insurance Covering Sickness, Accident and Death; third, Old Age Pensions.

Admiral J. B. Murdock, Commandant of the Brooklyn Navy Yard, speaking of the operation of the Federal Compensation Law stated that during 15½ months 2765 men had been treated at the yard dispensary for injuries ranging from minor contusions, lacerations and sprains to serious injuries. The method of determining compensation is comparatively simple. Application has to be made to the proper authorities at the yard accompanied by a medical certificate. This information, properly visèd, is forwarded to the Secretary of Commerce and Labor at Washington, who, alone, has authority to pass upon the claim. No claim can be made unless the disability continues for 15 days or more and as a rule an interval of two or three weeks elapses after the application is made before a decision upon it is received. From July 1 to October 23 of the present year 66 men have been out for an average of 55 days. The longest term of absence is something over 350 days, resulting from a severe injury to the left heel.

During the past 9 months $17,500 have been paid out in compensation. This item has nothing to do with the indirect expenses of administrating the act, but this additional expense is undoubtedly very small, for the medical and clerical forces of the yard have not been materially increased to handle the additional work entailed by the operation of the compensation act.

Henry R. Towne, of the Yale & Towne Manufacturing Company, Stamford, Conn., presented a short paper dealing with the features installed at this plant for the comfort and health of the employees. He referred to the provision for heating, ventilating, artificial lighting, sanitation, removing of dust, general cleanliness, and the like. In all, the permanent investment is about $100 per capita, and the annual operating expenses average about $20 per capita; of this latter amount it might safely be considered that one-half was absolutely necessary for the operation of the plant and that the balance was contributed by the company for the welfare of the employees. The factory inspector of the State of Connecticut has said that he considered this plant the model plant of the State.

Old-age Pensions in England

J. R. Clynes, M. P. stated that up to October of this year 683,000 old-age pensions had been granted under the English old-age pensions act. The amount thus paid was at the yearly rate of £6,064,000 ($30,000,000). In discussing the question of old-age pensions it is frequently stated by opponents that the majority of aged dependent people reach this condition through their own unwise or immoral acts. A commission appointed in 1894 particularly investigated this question throughout the alms houses of England and reported that less than one per cent. of the alms-house inmates were in a condition of pauperism through their own fault.

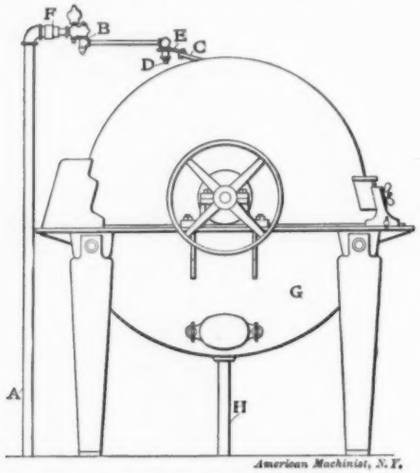
John Williams, Commissioner of Labor for the State of New York emphasized the need of adequate factory inspection by trained inspectors and submitted the following figures as showing the decrease of accidents from power-driven machinery to the total number of accidents during the past four years. In 1906 such

accidents from power-driven machines aggregated 47 per cent. of the total; in 1907, 46 per cent.; in 1908, 44 per cent.; in 1909, 43 per cent. This decrease, Mr. Williams inferred, if he did not directly state, is due to the rigidity of factory inspection. Unfortunately the force of these remarks was lost by a statement to the effect that he could take any intelligent man, even with nothing but a common-school education and in a short time train him into an efficient factory inspector, capable of analyzing the operations of power-driven machinery, determining the points of danger and prescribing suitable safeguards. A following speaker vigorously attacked this position claiming that such inspectors should be men possessed of the best engineering education and training.

Water Supply for a Grindstone

By Geo. L. Colburn

A method for spreading water evenly over the face of a grindstone is illustrated in the line cut. As very little water is necessary with this device, there is no



WATER SUPPLY FOR A GRINDSTONE

surplus to be thrown off of the wheel by centrifugal force. *A* is the water-supply pipe; *B*, the joint of an ordinary gaslight bracket; *D*, the nozzle supplying water to the grindstone; *E*, a piece of sheet copper; *C*, a sheet-rubber scraper; *F*, a reducing coupling with nipples for fastening gas bracket to water-supply pipe; *G*, the waste-water pan, and *H*, the waste pipe. This water-supplying device is in use at the New Bedford Textile School.

According to a writer in the *Scientific American*, a very handy tool can be made from an old pair of scissors or shears by cutting one blade with a set of saw teeth inclined toward the handle. These teeth hold the material fast, and prevent it slipping toward the point of the shears. Rubber sheeting, strips, and all kinds of soft packing can be easily cut with square or inclined ends.

Forthcoming Meetings

National Society for the Promotion of Industrial Education, annual convention, December 1, 2 and 3, Milwaukee, Wis. J. C. Monaghan, secretary, 20 West Forty-fourth street, New York City.

American Society of Mechanical Engineers, annual meeting, New York City, December 7-10. Calvin W. Rice, secretary, United Engineering building, New York City.

American Society of Agricultural Engineers, third annual meeting, December 28-29, 1909, Ames, Ohio. F. W. Chase, secretary, University of Nebraska, Lincoln, Neb.

Business Items

The United Engineering and Foundry Company has placed with Tate, Jones & Co., Incorporated, a contract for equipping its three open-hearth steel furnaces and its two annealing furnaces with oil-burning appliances.

The American Specialty Company, of Chicago, has recently been appointed sole export agent for the line of portable electric drilling machines manufactured by the Van Dorn Electric and Manufacturing Company, of Cleveland, Ohio. The American Specialty Company also has the agency for these tools in the Chicago and central western districts.

Business Opportunities

Knaack & Zehms, Sheboygan, Wis., will build a garage.

Hackner Altar Works, La Crosse, Wis., will erect a new factory.

The cheese factory of M. Felton, at Seymour, Wis., was burned.

Highland Spring Company, St. Paul, Minn., will erect a bottling house.

The Corwith (Iowa) Tile and Brick Works will rebuild its plant.

L. O. Larson's machine shop at Courtney, N. D., was destroyed by fire.

The Winsted (Conn.) Hosiery Company is planning a four-story addition.

The Gypsum City Bottling Works, Fort Dodge, Iowa, will erect a plant.

The Lynch Lumber Mill, at Anniston, Ala., recently burned, is being rebuilt.

The Bantam (Conn.) Anti-Friction Company is erecting a new building.

The A. I. Root Printing Company, Omaha, Neb., will erect a $25,000 addition.

The Peters Pump Company, Kewanee, Ill., will build an addition to its plant.

The Eckart Packing Company, Fort Wayne, Ind., is erecting a three-story addition.

The Detroit (Mich.) Screw Works will erect a new four-story building to cost $50,000.

The Deane Steam Pump Company, Holyoke, Mass., will erect a new machine shop.

The National Candy Company, Grand Rapids, Mich., will build a four-story factory.

The Gulf, Colorado & Santa Fe Railroad will erect car shops at Sweetwater, Texas.

M. E. Smith Company, Plattsmouth, Neb., overall manufacturers, will erect a factory.

The New York Central Railroad will rebuild a roundhouse at Canandaigua, N. Y.

The New Hampshire State Hospital, at Concord, N. H., is building a new power house.

The Dominion Iron and Steel Company, Montreal, Canada, will erect another rod mill.

The Lambert Hoisting Engine Company, Newark, N. J., will erect a new machine shop.

J. J. Shaffner, of Gering, Neb., will erect a building for the manufacture of cement blocks.

Kertscher & Co., Elmira, N. Y., cabinet manufacturer, is erecting a two-story addition.

The plant of the Chicago Hose and Rubber Company, at Wilmington, Del., is to be enlarged.

The plant of the American Steam Packing Company, Medfield, Mass., was burned. Loss, $10,000.

The Emerson Typewriter Company will move its Menominee, Ill., plant to Woodstock, Ill.

Plans have been drawn for an additional building for the Regal Shoe Company, Milford, Mass.

N. H. A. Davidson, of Chicago, Ill., will erect a denatured alcohol plant, at Eagle Grove, Iowa.

The William J. Lynch Company, Newark, N. J., leather manufacturer, is erecting a new factory.

The George W. Richardson Company, Newburyport, Mass., will build an addition to its comb factory.

Fire did $100,000 damage at the mill of the Davis & Sargent Lumber Company, at Lowell, Mass.

Max Hertz, Newark, N. J., leather manufacturer, will erect a $10,000 factory at 62-66 Oliver street.

The Cambria Steel Company is said to be contemplating improvements and additions at Johnstown, Penn.

The Haney-White Company, Philadelphia, Penn., lumber and mill work, will erect a new $75,000 building.

The Seton Leather Company, Newark, N. J., is having plans prepared for a new plant in Belleville.

The New Method Company, Mansfield, Ohio, manufacturer of gas ranges, will erect two additional buildings.

Levering & Garrigues, West Dunellen, N. J., will enlarge its shop. The company manufactures structural iron.

Louis F. Mohr & Co., New York, organ manufacturers, have purchased site in Elizabeth, N. J., for a plant.

The American Radiator Company, with head offices in Chicago, will erect a branch plant in Kansas City, Mo.

The Lagerquist Carriage Company, Des Moines, Iowa, is building a new $25,000 automobile and carriage factory.

The United States Envelope Company, of Springfield, Mass., and elsewhere, will establish a plant in Cincinnati, Ohio.

The Trenton (N. J.) Spring Mattress Company will erect an addition to be used for the manufacture of wire specialties.

Puffer & Hubbard, Minneapolis, Minn., manufacturers of wheelbarrows, tanks, etc., may locate a mill in Ladysmith, Wis.

The Elmira Machine Company, of Grover, Penn., will move its plant to Union, N. Y. The company manufactures metal and wooden novelties.

F. H. Wilbur & Son, Lestershire, N. Y., doing automobile repairing and machine work, are in the market for an 8-foot lathe, new or second hand.

Plans have been prepared for a new heating and lighting plant for De Pauw University, at Greencastle, Ind. J. C. Cosner is chief engineer.

The Cumberland (Wis.) Fruit Package Company, capitalized at $25,000, will erect a plant for the manufacture of the Ewald folding cherry box.

Broten & Dyerson, Blanchardville, Wis., have incorporated as the National Manufacturing Company and will erect a blacksmith and wagon-repair shop.

The Simmons Manufacturing Company, Kenosha, Wis., making wire mattresses, iron beds, etc., has increased its capital to $4,000,000, and it is said is planning the erection of additional plants.

The Formofume Company, Michigan City, Ind., has established a plant for the manufacture of Formofume in-door air moistener, liquid disinfectant and disinfecting devices. Would like catalogs from manufacturers interested.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: December 7—Bolts and nuts, twist drills, files (schedule 1981), straight shank drills, set screws, emery wheels (schedule 1977), hard-drawn brass rod (schedule 1983), round brass rod (schedule 1975), steel (schedule 1977), pipe fittings, valves, brass unions (schedule 1982), brass globe valves (schedule 1976); December 14—Open turret lathe (schedule 1996), hacksaw blades, files, portable rivet forges (schedule 1990); December 28—Planer, matcher and molder, combination power saw, universal woodworker and borer (schedule 1997); January 11—Metal furniture (schedule 1969).

New Incorporations

Bartnett Automobile Tire Company, New Rochelle, N. Y. Capital, $80,000. Incorporators, F. A. Bartnett, P. J. Leahon.

Lewell Manufacturing Company, Chicago, Ill. Design, manufacture and sell machinery. Capital, $30,000. Incorporators, Geo. E. Chamberlain, E. Eugene Gilman, etc.

Calumet Brass Foundry Company, Chicago, Ill. Manufacture castings, fittings, etc. Capital, $10,000. Incorporators, Chas. T. Mason, John Tulby, C. W. Lockard.

Terry Automobile Company, Newark, N. J. Manufacture automobiles, motor cars, wagons, etc. Capital, $25,000. Incorporators, Thos. D. Vandervoort, R. M. Terry, T. L. Terry.

American Patented Specialty Company, Chicago, Ill. Manufacture and sell patented articles and machinery. Capital, $10,000. Incorporators, D. F. Keller, J. J. Mattas, M. E. Renaud.

Lowe Motor Supplies Company, New York. Manufacture automobile machinery, appliances, etc. Capital, $100,000. Incorporators, F. Lowe, M. Whitelaw, New York; M. Brown, Boston.

Atlantic Automobile Supply and Exchange Company, Camden, N. J. Capital, $125,000. Manufacture automobiles, cars, wagons, etc. Incorporators, F. W. Renwick, H. W. Wiggins, V. D. Renwick, Jr.

New Catalogs

J. E. Snyder & Son, Worcester, Mass. Catalog of upright drills. Illustrated, 54 pages, 6x9 inches, paper.

Bryant Chucking Grinder Company, Springfield, Vt. Catalog describing chucking grinder. Illustrated, 50 pages, 6x9 inches, paper.

Union Steam Pump Company, Battle Creek, Mich. Catalog of air compressors. Illustrated, 72 pages, 6x9 inches, paper.

The L. S. Starrett Company, Athol, Mass. Supplement to catalog No. 18, showing new tools. 32 pages, 5x7½ inches.

The Cullen-Atkinson Company, 120 Allyn street, Hartford, Conn. Circular illustrating and describing Peerless portable annealing oven.

Keuffel & Esser Company, Hoboken, N. J. Booklet containing directions for K. & E. calculator. Illustrated, 16 pages, 3x5 inches, cloth.

The Carborundum Company, Niagara Falls, N. Y. Vol. VIII, Revised American Statesmen Series, Benjamin Franklin. 3x6 inches, paper.

Nazel Engineering and Machine Works, Philadelphia, Penn. Catalog of Beché patent pneumatic forge hammer. Illustrated, 6x9 inches, paper.

Newark Gear Cutting Machine Company, 66 Union street, Newark, N. J. Catalog of gear-cutting machines. Illustrated, 64 pages, 6x9 inches, paper.

Pennsylvania Steel Pulley Company, Pittsburg, Penn. Catalog describing Keystone steel split pulleys. Illustrated, 40 pages, 5½x7½ inches, paper.

United States Gas Furnace Company, Providence, R. I. Loose leaf catalog illustrating and describing gas-blast furnaces, pressure blowers, pyrometers. 6x9 inches.

Frank Mossberg Company, Attleboro, Mass. Catalog No. 12, describing wrenches, sheet-metal stampings, punches, screw-machine products, etc. Illustrated, 80 pages, 6x9 inches, paper.

Armstrong Bros. Tool Company, 339-357 North Francisco avenue, Chicago, Ill. Catalog of boring tools, clamps, cutting off and grinding machines, drill drifts, ratchet drills, tool post, nurling tool, etc. Illustrated, 72 pages, 3½x6 inches, paper.

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Successful superintendent of experience in the manufacture of small parts for a complicated machine, capable of handling and carrying on systematic and orderly and economical production; now employed. Box 947, AM. MA.

ILLINOIS

Mechanical engineer having eight years' practical workshop experience and nine years drafting and designing machinery and special tools, wants position as assistant superintendent in machinery manufacturing plant. Box 948, AMERICAN MACHINIST.

MASSACHUSETTS

Foreman toolmaker, at present employed, desires change. Box 872, AMER. MACHINIST.

NEW JERSEY

Technical graduate, with five years' experience on general machinery, printing press and automatic machine design. Box 957, AM. MA.

Wanted—Position as machinery salesman or inspector by young man (32), with shop and technical experience; moderate salary to start. Box 956, AMERICAN MACHINIST.

Salesman—Machine tool salesman as sales manager, having 15 years' experience, both in the manufacture and selling of machine tools; competent judge of condition and value of second-hand, and familiar with all makes in the United States; can give best of reference. Box 790, AMERICAN MACHINIST.

NEW YORK

First-class Brown & Sharpe automatic screw machine man can make cams and tools; would like position as foreman, twenty to forty machines. Box 953, AMER. MACH.

Man of ability, now employed, will consider responsible position in New York City; graduate Massachusetts Institute Technology; fifteen years' experience. Box 946, AM. MA.

Young man, Hollander (25), with technical and business education, four years' shop experience, three years inspection, speaking four languages, desires position as machinery salesman. Box 954, AMERICAN MACHINIST.

Mechanical engineer; Scotch; eight years' shop and drawing office; technical graduate; experience testing and designing; some commercial experience; wants position with consulting or manufacturing firm. Box 950, AMERICAN MACHINIST.

Superintendent or general foreman familiar with modern shop practice and equipment and the manufacture of interchangeable work; pattern, foundry, die, tool and drop forging and drafting room experience; American, 37. Box 932, AMERICAN MACHINIST.

Automobile engineer desires position, vicinity New York; expert at designing, improvement, laboratory work and engine testing; also construction, repairing and running; nine years' experience in French and American factories; highest references. Address "E. V. H.," AMERICAN MACHINIST.

Electrical engineer with highest references, wishes to form connection with good concern, preferably in or near New York; three years' experience in Mexico, five years in Chile; speaks Spanish and German fluently; has had wide experience, both in selling and constructing electrical, steam and hydraulic machinery; open for immediate engagement. Address "H. K. W.," AMERICAN MACHINIST.

OHIO

Experienced piece work and rate setter to take charge of machine shop. Box 943, AM M.

Works manager or general superintendent invites correspondence from reliable concern wishing to secure the services of a high-class executive with a clean cut record as an earning power. Box 949, AMERICAN MACHINIST.

OREGON

Master mechanic; responsible, live man experienced in construction and manufacturing in the States, Canada and South America; age 39. B. Nilius, St. Johns, Oregon.

PENNSYLVANIA

Wanted—Position as assistant manager by competent works office manager; best of references. Box 952, AMERICAN MACHINIST.

Mechanical draftsman, technical graduate, well up in automobiles, tools and special machinery, desires change. Box 951, AM. MACH.

Foreman, toolroom or general shop foreman, up-to-date in modern shop methods; at present employed; good reference; age 31. Box 914, AMERICAN MACHINIST.

Graduate, age 32, shop practice, designer of eleven years' experience on special and automatic machinery, apparatus, fixtures, adding machines, typewriters, etc.; expert on new design, developing new machinery, inventive and practical, desires responsible position where the best man only will do. Box 955, AMERICAN MACHINIST.

WISCONSIN

Mechanical and electrical engineer, 15 years' experience, desires position as shop engineer, designer or master mechanic. Box 931, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted—Practical manager, experienced in the manufacture of small interchangeable parts; must have experience. Box 325, Montreal, Canada.

CONNECTICUT

Wanted—Experienced mechanical draftsmen for detail work, in a concern manufacturing general rolling mill and hydraulic machinery; state age, experience and salary expected. Box 796, AMERICAN MACHINIST.

Wanted—In every machine trade center, a live man, with trade acquaintance, to sell a high-class and money-saving tool, already widely used and advertised; give age, experience and references. Box 888, AMER. MACH.

DELAWARE

Wanted—A man who is thoroughly familiar with case hardening and blueing; we have a good position for the right man in one of the finest firearms factories in the country. In reply, give age, experience and salary expected. Box 899, AMERICAN MACHINIST.

ILLINOIS

Wanted—Diemakers; high-grade men for small accurate work; toolmakers for gage, jig and fixture work; milling-machine operators for tool-room work; automatic screw-machine operators for Brown & Sharpe and other automatic screw machines; on this line of work we pay competent men 39 cents per hour; added premiums will make this rate average 42 cents per hour; hand screw-machine operators. In answer give full information. Address Department 1056, Western Electric Company, Chicago.

MASSACHUSETTS

Wanted—First-class draftsmen. Apply Supervisor of Drafting Room, General Electric Co., Pittsfield, Mass.

Wanted—An inspector of gears and gear cutting in a large jobbing shop; one who has had experience on this particular specialty preferred; state age, experience and wages expected. Boston Gear Works, Norfolk Downs, Mass.

Wanted—A practical pump man; one who can design, estimate power, efficiency and cost and superintend construction; would prefer a man who has had experience in steam engine and electrical work in connection therewith. Address, giving age, experience and references. "Pump," AMERICAN MACHINIST.

Wanted—Demonstrator; a large manufacturing company desires to communicate with a party or parties who have had practical machine shop experience to demonstrate to factories; must be able to give first-class references, steady and industrious; this company desires preferably parties to be not over 40 years of age; steady work guaranteed; state salary desired. Box 916, AMER. AACHINIST.

MICHIGAN

Wanted—Ten first-class toolmakers who have tools and understand jig and fixture work; customary wages. Box 936, AM. MA.

Wanted—First-class tool-room foreman on jigs and fixtures; one who can get rapid and accurate production from a first-class equipped tool room. Box 935, AMERICAN MACHINIST.

Wanted at once, toolmakers, die sinkers, trimming diemakers, machinists, automatic screw machine hands; state age, experience, customary wages and references. Buick Motor Company, Flint, Mich.

Wanted—Shop draftsman not less than forty years of age; man of general experience for works having a large machine shop, plate and sheet-iron work; one who is thoroughly capable of designing jigs and other shop appliances and having a general knowledge of structural work; a permanent position to the right man; give full particulars of experience, age and salary expected. Box 942, AMERICAN MACHINIST.

Draftsman Wanted—One A-1 layout man, familiar with current practice in automobile design; a thoroughly reliable and accurate man is required and one who can turn out work in reasonable time; to such a man a good salary will be paid and opportunity offered for advancement; we have openings also for a careful checker and two detailers and two experienced tool and jig designers; only first-class men with mechanical experience wanted. Reliance Motor Truck Co., Owosso, Mich.

MISSOURI

Wanted—Experienced machine tool salesman for Missouri, Kansas and Texas. W. R. Colcord Machinery Co., St. Louis, Mo.

Wanted—Traveling salesman for St. Louis territory; experienced in selling machinists' supplies. W. R. Colcord Machinery Co., St. Louis, Mo.

Wanted—Mechanical draftsman who has had experience designing woodworking machinery; state age, experience and give references. Apply Box 938, AMER. MACHINIST.

Wanted—An experienced man as foreman of machine shop employing about 100 men, who thoroughly understands the manufacture of woodworking machinery; must have occupied similar position; applicant will state age, experience and give references. Box 937, AMERICAN MACHINIST.

NEW JERSEY

Wanted—A first-class lathe hand used to large crank shaft work; good wages paid. Trenton Engine Company, Trenton, N. J.

Wanted—Four experienced draftsmen on gas engines; state experience, reference and salary expected. Box B, AMER. MACHINIST.

NEW YORK

Good header men wanted for night work; good pay, steady job. Box 918, AM. MACH.

Gear cutter; man who thoroughly understands and can produce accurate work. "F. I. A. T.," Poughkeepsie, N. Y.

Wanted—Two or three first-class diemakers on small and medium blanking, forming and drawing dies for tin boxes. Box 933, AM. M.

Wanted—First-class draftsman on steam turbine work; state experience and salary expected. Kerr Turbine Co., Wellsville, N. Y.

Designers wanted, experienced on fine gage, jig and fixture work; give detail of experience, age and rate expected. Box 941, AM. M.

Wanted—Experienced toolmakers on fixtures and gages; state experience, age and rate per hour expected. Remington Arms Co., Ilion, N. Y.

Foreman for brass and aluminum foundry; must be thoroughly practical and competent to produce high quality of work. "F. I. A. T.," Poughkeepsie, N. Y.

Wanted—Machine shop foreman for shop employing about fifty men; jobbing shop on heavy work; state experience, age and salary wanted. Box 887, AMERICAN MACHINIST.

Wanted—Planer hands, lathe hands and all-round machinists; steady job; no strike; state experience and wages wanted. Address W. B. Peirce, 169 Vandervoort St., North Tonawanda, N. Y.

Wanted—A thoroughly competent web printing press draftsman; man of experience and ability can have permanent position at high salary; communications confidential. "W. W. C.," AMERICAN MACHINIST.

Wanted—Clerk for drafting room in engineering works in small town western New York; to enter and index drawings, superintend filling, copy lists of quantities, etc. Give fullest particulars and state salary, addressing Box 939, AMERICAN MACHINIST.

General office man, bookkeeper, stenographer, typewriter; age 25 to 25 years; capable of development into broad gage confidential man; full particulars and references required with application; salary to start $20. "Mfg. Corporation," AMER. MACHINIST.

Wanted—Experienced man in time study and planning work in connection with a manufacturing business; opportuity is limited only by the efficiency of the man; state experience and salary expected during the period of becoming familiar with business and demonstrating of ability. Box 944, AM. MA.

OHIO

Wanted—First-class machinists; no labor troubles. The Heisler Co., St. Marys, O.

A gas-engine salesman; mechanical engineer to take charge of office. Box 896, AM. MACH.

Machinists wanted on machine tools and erecting floor; no labor troubles. Lima Locomotive and Machine Co., Lima, Ohio.

Wanted—Experienced draftsman for designing and checking; state age, experience and wages. Address "C. W. R.," AM. MACH.

Wanted—First-class sheet-metal man, capable of managing sheet-metal department in a large automobile concern; must be thoroughly experienced in punch and die work; state age, experience and salary. Box 945, AMERICAN MACHINIST.

Machinists—We are increasing our output and invite application from machinists with experience on planers, turret lathes, boring mills, milling machines, screw machines, etc.; state fully, experience and wages. Foos Gas Engine Co., Springfield, Ohio.

Applications wanted from erectors on pumps, compressors, etc.; also from planer hands; boring mills and big radial operators for heavy work; state wages expected, past experience and names of past employers. Z. Y. X., AMERICAN MACHINIST.

Production expert for large shop manufacturing compressors and other heavy and medium machinery; must be competent to devise economical method of machining and understand cutting tools thoroughly; applications considered only from those having experience and record in such work. A. B. C., AM. MA.

Wanted — First-class machinists, lathe, planer, brass molders, drill press, screw machine, boring and milling machine operators, die sinkers and patternmakers who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Building, Cleveland, O.

PENNSYLVANIA

Wanted—Toolmakers, machinists, assemblers and all kinds of first-class mechanics on automobile work. Box 934, AMER. MACHINIST.

Help Wanted—Designer and draftsmen on general machinery; first-class designer, capable of taking charge of work; also one draftsman wanted. Box 890, AMER. MACH.

Wanted—Large engine shop wants progressive head foreman to increase production; excellent opportunity; position steady; must be an aggressive hustler with experience; give references. Address Box 910, AMER. MACH.

UTAH

A first-class toolmaker experienced on all kinds of fixtures and cutting tools for interchangeable high-grade work; 50 cents per hour. Address Room 2 Board of Trade Bldg., Salt Lake City, Utah.

WISCONSIN

Draftsman Wanted—About thirty years old, having had experience on paper machines; none others need apply; send references, very full particulars as to experience and lowest salary required. Box 853, AMER. MACHINIST.

Miscellaneous Wants

Caliper catalog free. E.G. Smith, Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Machinery to order, or will purchase good patents. Interstate Machinery Co., Troy, N. Y.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Machines designed; automatic special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emery & Co., Newark, N. J.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Arthur C. Mason, designing engineer; practical working drawings; special machinery developed. 227 Canal St., New York City.

Metal specialties manufactured, models, dies and special machinery; inventions perfected. Villinger Mfg. Co., Williamsport, Pa.

Special machinery developed; practical working drawings prepared by experienced designers. The Engineering Service Co., 413 Fort Dearborn Building, Chicago, Ill.

Wanted—Purchaser for No. 2 Farwell milling machine, Grant hobbing machine and Gisholt tool grinder; all practically new and in A-1 condition. Box 755, AMER. MACHINIST.

Lathe and machine work of every description, paterns, gear cutting, screw machine work, iron, brass and aluminum castings. The Sipp Electric & Machine Co., Paterson, N .J.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

An old established English firm is prepared to take out and purchase really good sound inventions for Europe, or will make and sell on royalty; bankers reference given. Fastnut, Ltd., 60, Aldermanbury, London, Eng.

Castings, pattern and machine work; having capacity in our foundry, pattern and machine shops, above our present requirements, we would like to take on a few good contracts for building machines requiring both foundry and machine work. Wm. E. Hill & Co., Kalamazoo, Mich.

Wanted—New or used tools; 21″ to 28″ horizontal and vertical turret lathes; universal milling machine; 24″ drill press; 18″ to 24″ lathe and other tools. Give price, make and where they can be seen by mail only. Eadie Vehicle Gear Co., 1 Madison avenue, New York City.

Wanted—To purchase a machine and foundry business, employing not less than fifty men; must have an established trade, show good profits and good reason for selling; purchasers wish business to combine with other lines now being manufactured. When writing give full particulars. Box 940, AMERICAN MACHINIST.

For Sale

For Sale—No. 51 National-Acme 4-spindle automatic screw machine, with countershaft and 32 collets 1/32″ to ¼″, used but for a few weeks and in perfect condition. The Vote-Berger Company, La Crosse, Wis.

For Sale—Modern new steel brick lined shop and tools, four years in operation; new tools, electric crane, gas engine and motor drive; running day and night since January; owners will retain part interest and give management to right party; located in Central West. Box 760, AMERICAN MACHINIST.

For Sale—One factory or storage building 215′x64′ heavy frame construction two stories high with ell 130′x30′; cost $16,000; also one steel stack, 100′ high and 4′ diameter; building two years old; located on railroad siding; will sell cheap. Send for blueprints and photographs. Box 922, AMERICAN MACHINIST.

The Lester Automatic Screw Machine

A Novel Machine Equipped with Three Work Spindles, a Six Hole Turret, Two Independent Threading Spindles and Three Cross Slides

BY F. A. STANLEY

In the accompanying engravings is illustrated a new automatic screw machine in which many features of novelty and interest are incorporated. This machine is the Lester automatic, manufactured by the Davis Sewing Machine Company, Dayton, Ohio.

Figs. 1 and 2 show respectively front and rear views; Figs. 3 and 4 represent the machine from the head end, illustrating incidentally the method of driving the cam-shaft mechanism, also the indexing mechanism for the spindle-carrying cylinder.

As will be seen upon examination of these general views, the machine has three work-carrying spindles to receive the bar stock, while the turret for the tools has six holes. The work spindles, or rather the cylinder in which they are carried, may be indexed either one-third or one-sixth of a revolution at each advance, thus bringing each spindle in succession into position opposite each tool position, or when indexed one-third of a turn, presenting the work opposite every other hole in the turret. There are three forming and cutting-off cross slides, two of which are on the horizontal center line, while the third is located obliquely above and to the front of the main shaft through the turret; thus six tools may be used in the longitudinally traveling tool slides, and three in the radially located cross slides.

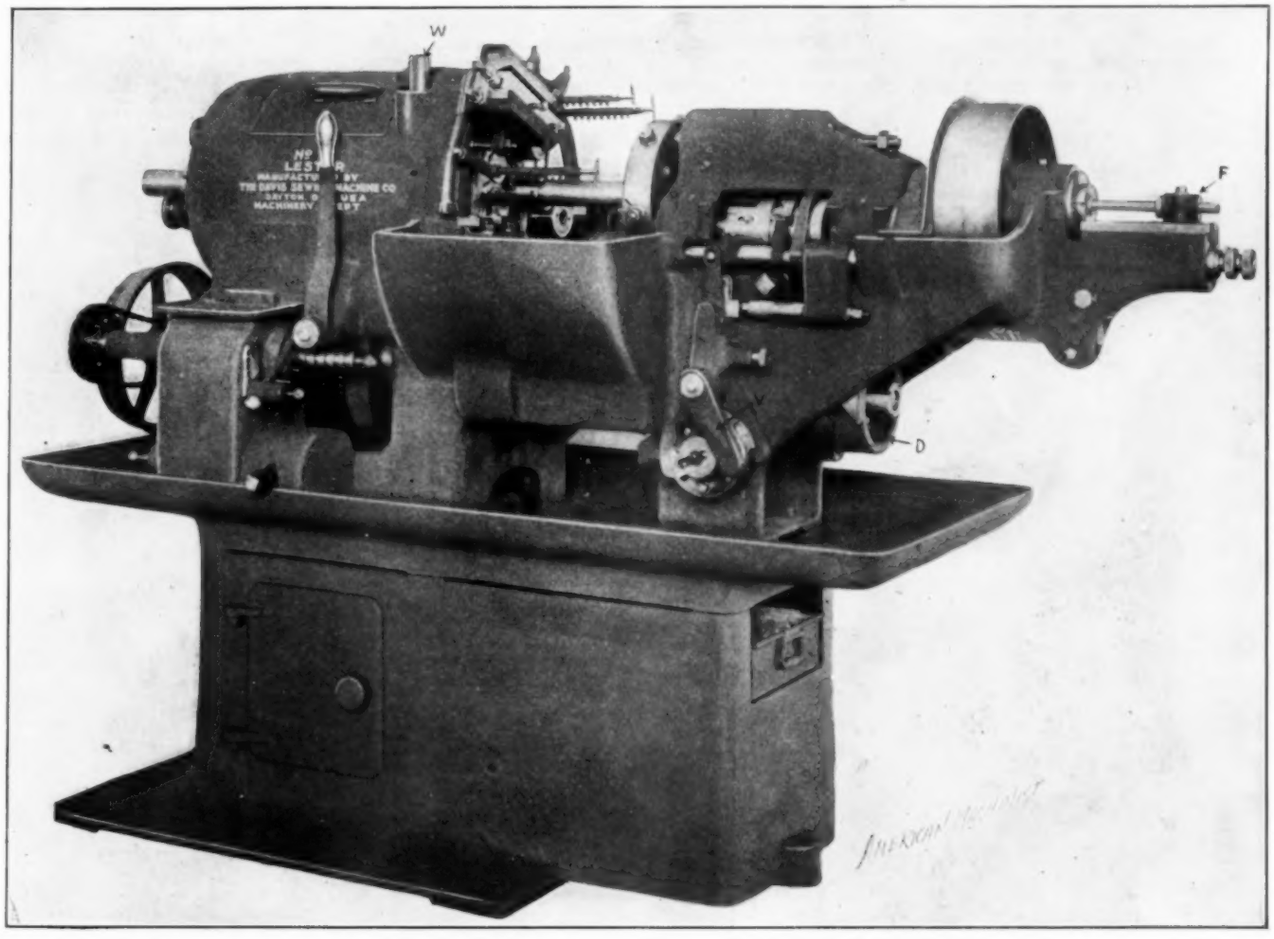


FIG. 1. THE LESTER AUTOMATIC SCREW MACHINE—FRONT VIEW

The Stock and Tool Positions

In ordinary operations, such as on regular screw work, the three bars of stock held by the three spindles are presented successively to three longitudinally moving tools. Each tool may be of different character and the rods fed forward progressively at each indexing movement of the spindle-carrying cylinder, a completed piece being severed from each bar after it has been operated upon in three positions. Where it is desired to make simultaneously three duplicate pieces, the spindle-carrying cylinder is locked in position and the three bars of stock are fed at the same time, each to its own tool. Or, the rods may be simultaneously operated on by three tools of different character, thus producing at once three pieces of work of different form.

One of the three bars of stock may be presented in one position after another, to three tools of different character, which take a variety of cuts. The spindle cylinder then indexes, presenting the unfinished pieces to three other tools which may be of any desired character, thus giving with the three side tools, nine cuts, a sufficient number for quite complicated work. However, by means of combination tools an even greater variety of cuts can be utilized.

With three roughing and three finish-

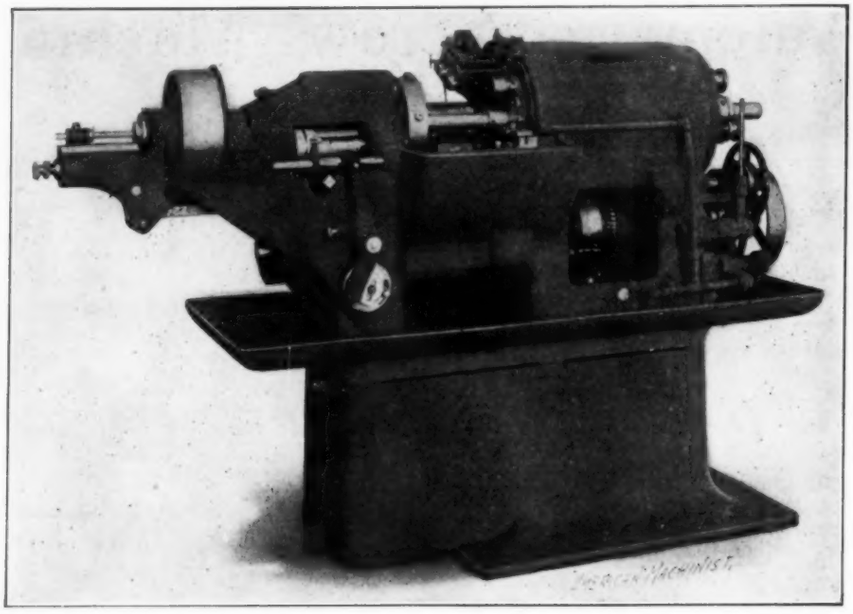


FIG. 2. THE LESTER AUTOMATIC SCREW MACHINE—REAR VIEW

ing tools in the turret, three bars of stock in the work spindles may be fed out to the required length, indexed to bring them opposite the roughing tools; after the roughing operation again indexed for completion with the finishing tools, and, as the latter are withdrawn from the work, the pieces are severed by the three cutting-off tools. In this operation the stock-feed and chucking mechanism operate only at every other advance of the spindle-carrying cylinder. It is obvious from the foregoing that a large number of combinations of stock-feeding and tool-cutting operations may be obtained if required with this machine.

THE WORK SPINDLES

The work spindles carried in the cylinder have bearings of ample proportions, are hardened and ground and run in split, taper, phosphor-bronze boxes fitted in internally tapered iron bushings which are readily adjusted to compensate for wear. One of these spindles is shown in Fig. 5, while the carrying cylinder with the three spindles in place is shown in two positions in Fig. 6. As indicated in Fig. 5, the driving gear for the spindles is located between the bearings. At the front of this gear is shown the ball-thrust bearing that takes the end pressure on the spindle under the action of the cut. All portions of the spindle bearings are inside of the cylinder, which at each end is provided with large oil reservoirs to insure constant lubrication of the spindle and driving-shaft bearings as well as of the spindle gearing. All the other bearings, it should be noted, such as worm and cam shaft, as well as those for the spindles, have removable bushings so that accuracy of alinement may be preserved, due to these renewable bushings which are fitted in seats bored in the solid frame.

INTERNAL CONSTRUCTION OF SPINDLES

An important feature of the work spindles is the arrangement whereby the usual spring collet or chuck may be

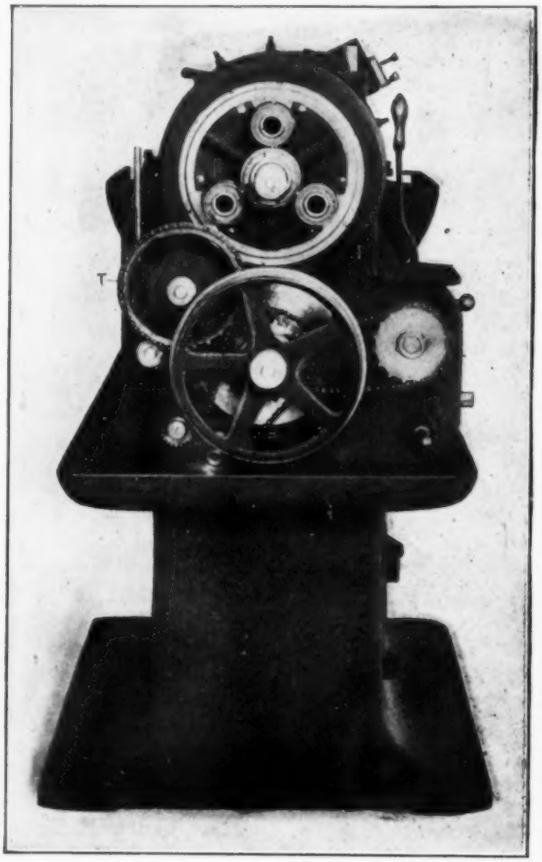


FIG. 3

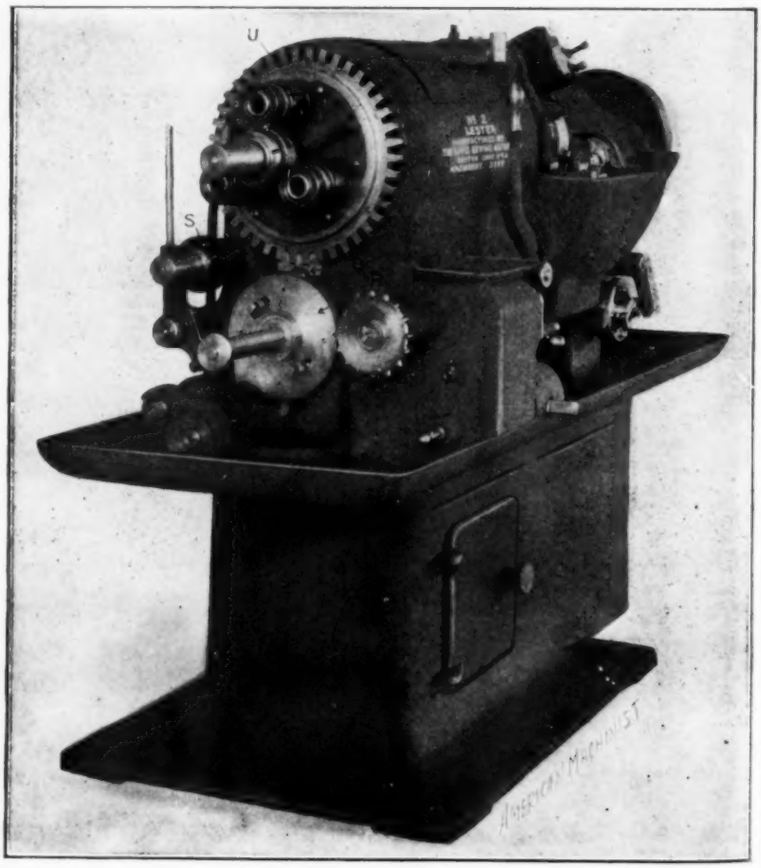


FIG. 4

END VIEWS OF LESTER AUTOMATIC SCREW MACHINE, SHOWING INDEXING MECHANISM AND GEAR-BOX DRIVE

closed upon the stock without end movement. The interior mechanism may be described as follows:

At *A*, Fig. 5, is shown the pair of fingers which, when opened by sliding cone *B*, close the chuck upon the work. This closing action is brought about by a short tube slotted at opposite points near its rear end so as to engage with depending lugs formed at the front ends of fingers *A*, while the outer end of the tube is threaded and fitted to chuck-closing cap *C;* the latter slides inside the nose of the spindle and is bored out conically to fit the tapered nose on the spring chuck. The back end of the chuck itself presses at all times against an internal tube extending to the rear end of the spindle, where it abuts against a cap *C'*, fixed to the spindle. It will be apparent that the chuck is thus positively prevented from moving toward the rear at any time, and, of course, it cannot move toward the front in closing as the action of closer *C*, when drawn back over the chuck, merely presses that member against the retaining tube just referred to.

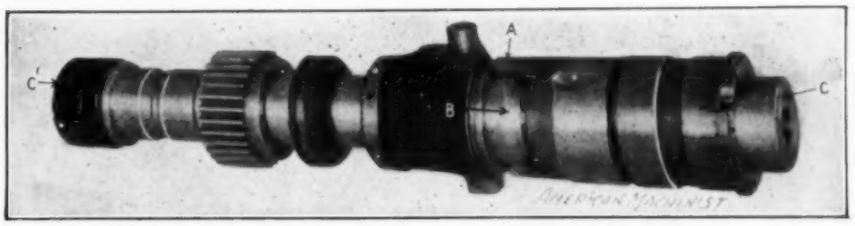


FIG. 5. ONE OF THE WORK SPINDLES

In operation, cone *B* is actuated by the lug on the under side which engages with a pocket in a sleeve slid to and fro on the main shaft through the spindle carrier by means of cams on the cam shaft below. Cone *B* may also be slid by hand when setting up, by simply actuating the hand lever shown at the front of the head in Fig. 1. For this purpose the round stud at the top of cone *B* engages a fork on the lever arm inside the head.

The Spindle Drive

Referring to Figs. 1 and 2, the driving pulley for the spindles is shown located at the right-hand end of the machine. This pulley is a plain affair for single belt drive though nine rates of speed are obtainable through the medium of the cone and plain pulleys for the countershaft. The long shaft upon which the pulley is mounted extends the full length of the machine, passing on its way through the quill forming the body of the tool turret, and having near its rear end a driving gear meshing with the gears upon the three work spindles which are rotated constantly when the driving pulley is in motion. In addition to the work spindles, this driving pulley also actuates gearing through which two threading spindles are driven.

The design of the machine is such that work is tapped or threaded externally without reversing, the threading spindle being sufficiently retarded in its forward velocity during the cutting operation to allow the tap or die to cut at a low rate of speed until the thread is produced to the necessary length, when the speed of the threading spindle is greatly accelerated or increased beyond that of the work spindle to remove the tap or the die from the work. As the work spindles are thus always driven forward, the cutting tools are all right hand and of simple construction.

Cam Shaft Mechanism

At this point it will be well to consider briefly the cam-shaft mechanism by which the various tools are fed, the spindle carrier and the chucks operated, the stock feed manipulated. Fig. 7 shows the cam shaft with the various cams and disks assembled and on its end the driving pulley, which in the general views will be seen near the head end of the machine. This is a constant-speed pulley but through the medium of a pair of sprocket wheels and chain-driven gear box, 24 rates of speed are obtained for the cam shaft for each speed of the work spindle. In Fig. 7, cam *D* at the left-hand end of the shaft controls the speed of the cutting tools. This cam will also be seen in Fig. 1 at *D*. In action it engages a roll on the under side of a longitudinal rack whose teeth mesh with a spur gear which engages also at its upper side with rack teeth on the body of the tool-carrying turret, thus translating the helical movement of the cam surface into a direct longitudinal movement of the turret. Cam *D* gives a

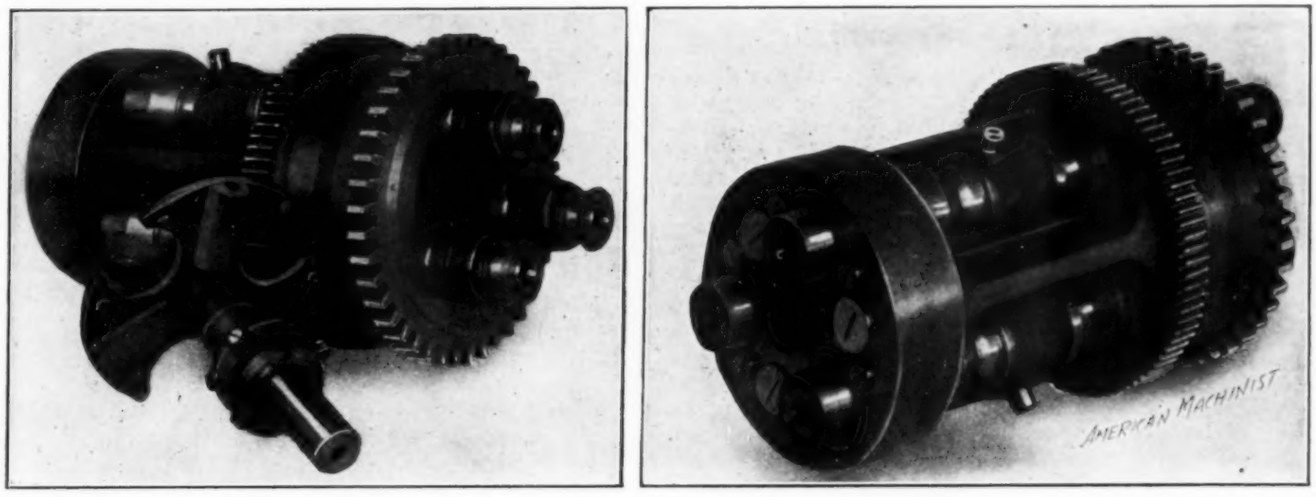


FIG. 6. THE WORK SPINDLES AND THEIR CARRYING CYLINDER

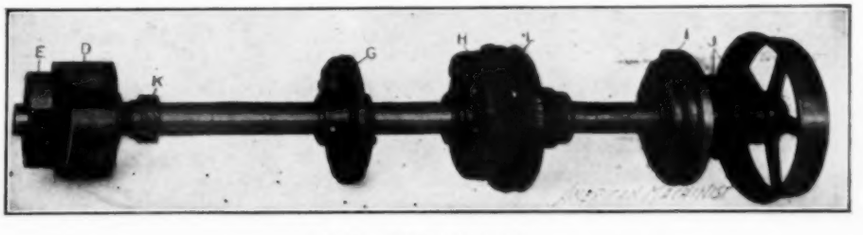


FIG. 7. THE CAM SHAFT

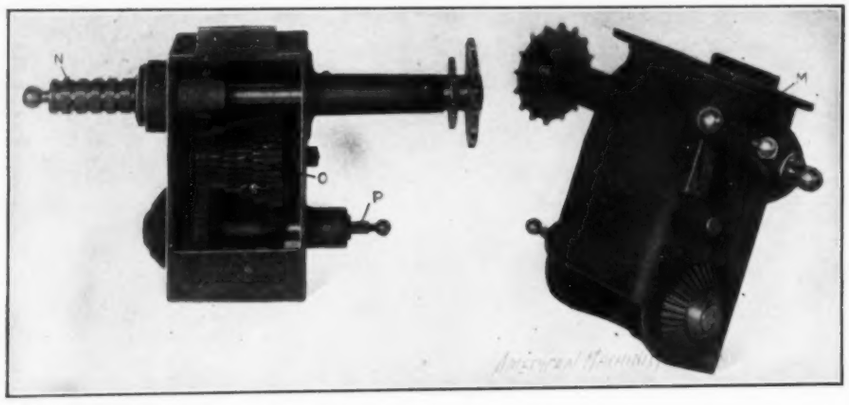


FIG. 8. GEAR BOX FOR DRIVING CAM SHAFT

maximum cutting movement of about 4¼ inches, a series of four of these cams being furnished to cover different classes of work.

At *E*, Fig. 7, is another cam surface whose function is the withdrawing of the turret tools and the feeding of the stock through the work spindles. The rack, when operated by this cam, reciprocates sliding block *F*, Fig. 1, carrying a long rod which reaches through the turret and work cylinder and engages a sliding sleeve at the end of the head by which the stock-feeding tubes are actuated at the proper moment. Block *F* may be adjusted accurately by a screw and graduated dial to give correctly any length of feed required ranging between the even inch lengths which are obtained by cams *D*. The rear ends of these stock-feed tubes are plainly shown in Fig. 6, and it will be noticed that each is provided with a grooved collar adapted to be engaged by a roll on the sliding sleeve carried by the hub extending from the three-winged head plate shown detached from the cylinder and lying at the front in Fig. 6. Ordinarily, only one of these tubes is operated at a time, but where it is desired, as previously noted, to machine three pieces simultaneously and therefore necessary to feed three bars of stock at the same instant, the three grooved collars are actuated in unison. Only a slight adjustment of a block at the front end of the spindle-carrying cylinder is required to change for the feeding of the three bars simultaneously.

Referring again to Fig. 7, disk *G* carries the cross-slide cams, disk *H* the chuck opening and closing cams. Cams *I* accomplish the indexing of the work spindle carrier, while sprockets *J* drive the speed-change gearing and the mechanism that rotates the work cylinder after the lock bolt has been withdrawn. The spiral gear *K* operates a cross shaft upon which the cams are mounted which control the operation of the two threading spindles.

THE GEAR BOX

The halftone, Fig. 8, illustrates the external appearance and the interior mechanism of the gear box by which the 24 rates of speed for the cam shaft are secured.

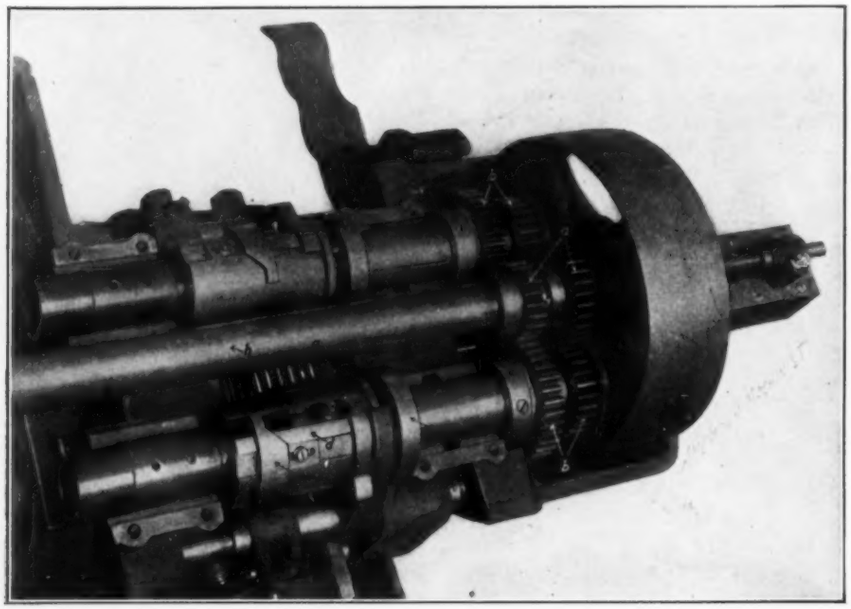


FIG. 9. THE THREADING SPINDLES AND THEIR OPERATING MECHANISM

A few words of explanation will make the construction clear: The main shaft in this box, driven by chain and sprockets, drives a tumbler gear which may be engaged with any one of a series of six gears in the cone shown in the box. At the underside this cone meshes with two gears of different diameters, either of which may be connected by a push rod and sliding key with a bevel-gear shaft operating a worm through which the cam shaft is driven. The worm wheel acting as a driver for this shaft in this case may be seen at *L*, Fig. 7, and its location in the machine will be revealed upon inspection of the rear view of Fig. 2. Combining the movements of crank handle *M* and plug *N*, Fig. 8, gives six speed changes for gear cone *O*, this number being increased to twelve by sliding plug *P* to engage one after the other the two gears on the lower shaft and the number of speeds being again doubled, giving a total of 24, by changing the driving chain from one sprocket to the other. The gear-box mechansm may be thrown entirely out of operation by simply raising the lever to the top locking hole.

THE INDEXING MECHANISM

Figs. 3 and 4 give a good idea of the method by which the work-spindle cylinder is indexed and locked. The cylinder is fitted with a coarse-pitch toothed ring, or circular rack, hardened and accurately lapped to give correct tooth centers, and a three-tooth locking bolt is adapted to engage this ring from the under side as represented in Fig. 4 at *Q*. This locking member is held positively in engagement with the index ring by a concentric surface on a cam and the lock can be released only when the dwell on the cam has been passed, allowing the bolt to be pulled down by another cam. When this action takes place cam disks *R* which have been previously set to correct position, cause a clutch at *S* to be engaged, enabling the shaft on which this clutch is mounted to be actuated by sprocket *T*, Fig. 3, this resulting in the spindle-carrying cylinder being revolved by a spur pinion meshing with a large gear shown in place on the cylinder in Fig. 6.

The adjustment of cam disks *R* determines whether the cylinder shall be indexed at each step for one-third or one-sixth of a revolution, that is, for each hole or for every other hole in the tool turret. In either case it comes to rest before the toothed locking plate is forced again into engagement with indexing ring *U*.

THREADING SPINDLES

These spindles are clearly shown in Fig. 9 and the cam disks and levers by which their clutches are controlled and their advance to the work secured are seen at *V*, Fig. 1, near the right-hand end of the machine. The two pairs of gears for the two rates of speed for either spindle are shown

at *a* and *b*, Fig. 9. A clutch is formed between gears *a* and another in the form of a pin clutch is located at *c*. When the die is run on the work it is pressed forward by the cam-operated lever at the front until well on the thread, when it continues its travel without further assistance, the drive during this threading process being derived from the slower of the two pairs of gears and the pin clutch *c*. Upon reaching the end of the thread the sleeve *d* draws off from pin driver *c* and the fast gears are then thrown into action by the clutch formed between gears *a*, the threading spindle then running faster than the work until the die is withdrawn from the piece. This return movement of the die is facilitated by a coiled spring, which clears the die from the end of the piece as it runs off the thread.

Sleeve *d*, it should be noted, is merely a connecting member with a longitudinal

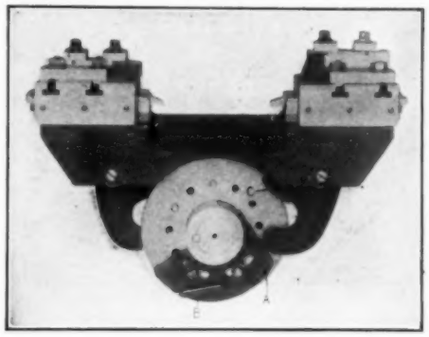


FIG. 10. THE CROSS SLIDES AND THEIR CAMS

slot which acts upon the roll carried by a secondary sleeve on the threading spindle causing the latter to rotate with the sleeve but allowing the spindle and die to slide forward freely when drawn upon the work in the process of cutting the thread.

The adjustable cams shown at *V* in Fig. 1 for controlling this mechanism are readily set to operate the clutches at the exact moment that the change in the speed of the threading spindles is required. A positive stop is adjustably mounted at *e*, Fig. 9, to determine the precise distance which the die shall travel on the work. When it is not necessary to thread or tap work, both of the threading spindles are drawn back by releasing a latch at *f* and the spindles are then held back without further end movement, leaving all of the six holes in the turret free to be used for cutting tools if desired.

The illustration, Fig. 9, is of further interest in that it shows clearly the position of the spur gear *g* which feeds the tool turret forward; the latter is not shown in place in the halftone, but when in position the rack teeth on the under side of its long hub which fits upon driving shaft *h*, mesh with pinion *g* just referred to. It will be seen that the end of the shaft carrying gear *g* is squared to receive a crank handle which is used when setting up for new work, and making adjustments. Similarly the end of the worm shaft for driving the main cam shaft is squared as represented in Fig. 1, to facilitate setting up operations.

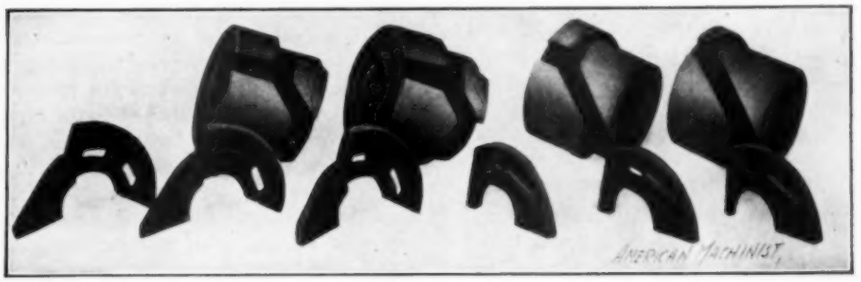


FIG. 11. COMPLETE OUTFIT OF LEAD AND CROSS-SLIDE CAMS

Cutting off and Forming Slides

The cross-slide mechanism is illustrated by Fig. 10, which shows the cam disk and cams for operating the levers whose upper ends are in the form of toothed sectors engaging with racks under the cross-slide blocks. These latter are provided with broad taper shoes on the guides for bearing surfaces and have gibs at the sides which, in conjunction with the taper shoes, take up any possible lost motion. The oblique slide above and at the front is operated by the front horizontal cross slide which has at one side a second rack engaging with a pinion on a shaft which, in turn, operates a vertical rack, the upper end of which is shown projecting above the head at *W*, Fig. 1. This rack serves to actuate a second pinion shaft which acts upon a rack attached to the oblique cross slide. Thus this slide operates in unison with the one below.

The faces of the slides at front and back are broad enough to permit all necessary side adjustment of forming and cutting-off tools; in the case of the oblique slide lateral adjustment is secured by means of a cylindrical hub formed on the body which enters a seat in the head casting and allows the slide to be moved in or out along the threaded stud which is seen passing through the lug under the slide and which locates the latter by means of stop nuts.

Cross-slide and Turret Cams

The cams for the front and rear faces of the cross-slide cam disks are of the form indicated in Figs. 10 and 11, the latter showing the set complete as provided with the machine. In Fig. 10 the cutting edge of the cam is shown at *A*, the return portion at *B*, which strikes the lug *C* on the cross-slide lever; the return movement of the cross-slide is thus a positive one. In this set of cross-slide cams, as shown in Fig. 11, there are three forming and three cutting-off cams covering all requirements for the different sizes of stock handled in the machine. The cams are easily adjusted to any point in the circle and are, therefore, well adapted to all kinds of work.

The lead cams are four in number, as in Fig. 11. They are but 8 inches in diameter, and with 4-inch stroke, give a 20-inch lead surface with only 12-degree angle. As shown, the cams are all of different leads and are readily changed as required to suit the work in hand.

Tool Equipment

The character of the cutting tools and

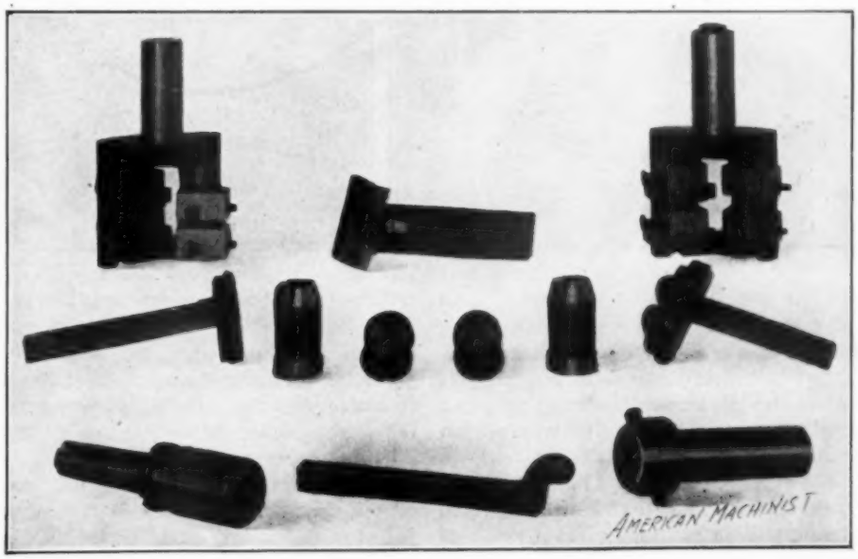


FIG. 12. GROUP OF CHUCKS AND TOOLS

other parts of the equipment is illustrated by Fig. 12, which shows a group of box tools, dovetail forming tools, spring chucks, single and double nurls, drill and tap holders. All of the tools used on the machine are of simple nature.

LUBRICATION, COUNTERSHAFT, ETC.

All of the spindles in this machine are driven by wide-face steel gears, some of which are case-hardened, and are incased and run in a reservoir of oil insuring constant lubrication. A gear-driven pump is attached to the machine insuring an ample supply of oil to all the tools, and provision is made for using oil drills.

The countershaft has three-step and single friction pulleys, and with the three driving pulleys provided gives a range of nine spindle speeds without changing the main line pulleys.

The machine is provided with shearing pins in the drives, and levers have flexible spring joints as a safeguard against possible accident to any part of the mechanism. The machine illustrated has a capacity for stock up to 1 inch diameter, and turns a length of 4 inches.

For supporting the outer ends of the three bars of stock, a neat arrangement is provided consisting of a light but rigid metal stand carrying at its upper end a concave shoe in which a disk with three holes for the bars of material is adapted to rotate with the indexing movement of the work-spindle cylinder.

The ideal condition in the use of phosphorus, says *The Engineer*, is that when just the right amount is added to the bronze, for casting purposes, to remove the oxide present in it.

The Brennan Monorail Car

Through the daily press our readers have seen accounts of the remarkable demonstration of a full-sized model of the Brennan monorail or gyroscopic car on the grounds of the British War Office, near Chatham, and they will be interested in the accompanying halftones, which show this remarkable development in the field of transportation.

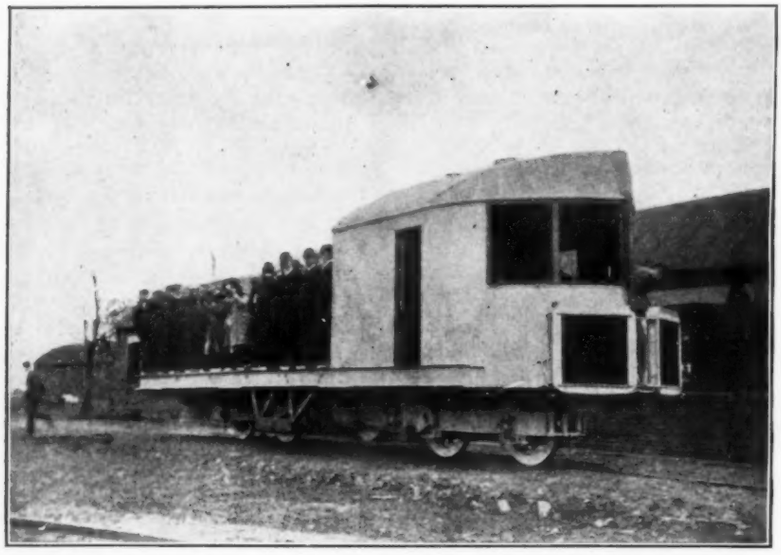


FIG. 1

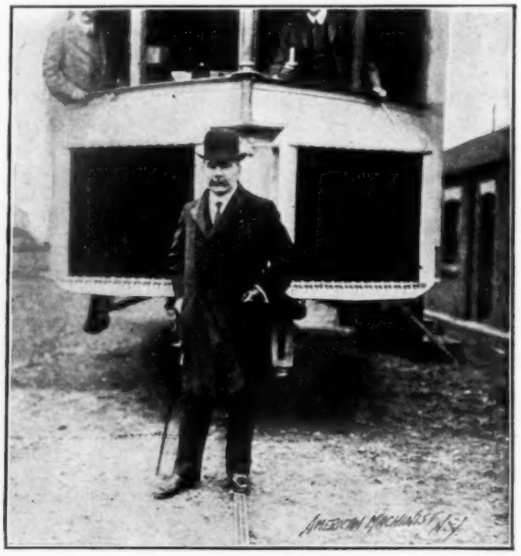


FIG. 2

THE BRENNAN MONORAIL CAR WITH A PORTRAIT OF THE INVENTOR

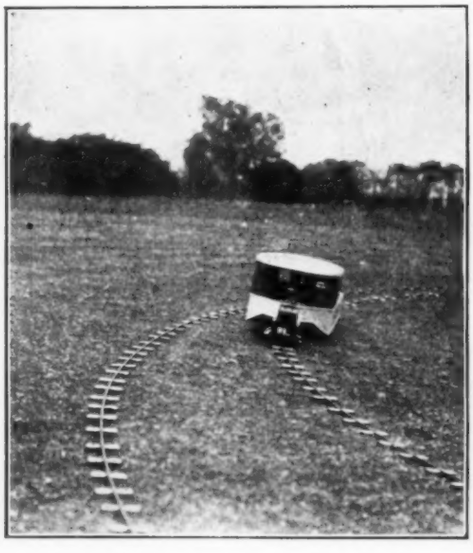


FIG. 3

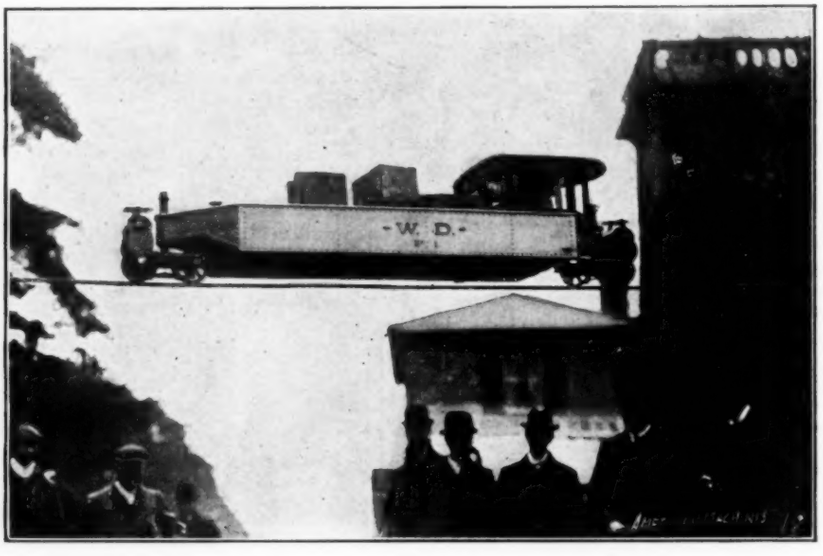


FIG. 4

PERFORMANCES OF A MODEL BRENNAN CAR

We are unable to give any information regarding the details of the mechanism, which, indeed, are closely guarded, beyond the fact that the balance of the car upon the rail, which balance is present when the car stands still precisely as when it is in motion, is obtained by two gyroscopes contained within the cab, which are of 3 feet 6 inches diameter, weigh some 1500 pounds each, and make 3000 revolutions

per minute. To reduce the power required to drive them, and also to give stability for a considerable period in case the power should fail, the gyroscopes are mounted in an airtight case from which the air is exhausted. Through the action of the gyroscopes the car stands up, precisely as a spinning top stands up.

Figs. 1 and 2 give two views of the 40-passenger carrying car, 40 feet long by 10 feet wide, when standing at rest upon its single rail, Fig. 2 showing also a portrait of the inventor, Louis Brennan.*

While this is the first exhibition of a full-sized car built upon this principle, it is not the first exhibition by the inventor who, some 18 months ago, gave a public demonstration before the Royal Society with a smaller or model car. Figs 3 and 4 show this model car in two striking situations, Fig. 3 showing its manner of negotiating a curve by inclining inward precisely as a bicycle rider would do under similar circumstances; while Fig. 4 shows the car performing a tight-rope act which, while more startling from the spectacular standpoint, is, of course, no more remarkable than the other performances shown.

An action which is somewhat analogous to that of Fig. 3, but not shown in any illustration, is that by which, when the passengers upon a car move bodily to one side, that side, instead of sinking, as would at first be expected, actually rises from the ground to a position something like that shown in Fig. 3, thus keeping the center of gravity above the rail.

The motive power is a gasolene engine mounted on the car, which drives an electric generator, which in turn drives motors for propelling the car and also for driving the gyroscopes.

Large claims are made for the invention, especially as regards a greatly increased speed and economy of operation, but on these points we have no opinion to express. The performance of the car from a mechanical standpoint is in itself a sufficient wonder without regard to its ultimate commercial possibilities.

According to the *Electrical World* the number of electrical plants installed for farms is increasing with marked rapidity and in their opinion it seems probable that the time is coming when well-to-do farmers everywhere, no matter how remote from a city or village containing a central station, will consider electricity as a necessity. At first the current for these country equipments will be generated by plants on the premises; but as the movement becomes more general, central-station companies favorably situated will no doubt find it to their interest to extend their limes along the rural highways to a far greater degree than is done at present.

*The photographs from which the halftones were made were supplied by Paul Thompson, New York.

Building Shops and Other Things Too Well

By R. E. Marks

It's funny how many of us get narrow and twisted ideas along certain lines and never know it until some fellow comes along and points it out in some way or another.

My friend Jones runs a machine shop making a pretty fair sort of a grinding machine and nurses a chronic grouch because a big automobile shop has just been built in his town that is one of the best in the country. It's a beautiful shop in every way, light, airy and has all the conveniences that you read about. Then too, it has another grievous fault, it pays better wages than he does. And, strange as it may seem, they actually got some of the best men in town to work for them.

Jones was having a serious attack of grouch-i-tis when Jackson dropped in the other day and was unkind enough to remark on the fine shop of the new auto company. That set off the fuse and the explosion followed as soon as Jones could think of adjectives enough to do the subject justice.

"Why, —— it, Jackson, no man has any right to build a shop like that anywhere, let alone in a town like this. It makes every mechanic dissatisfied with all the other shops and we can't afford to do things that way. Isn't money enough in grinders to do things like that.

"And the wages they pay are something scandalous. Why they took away my best foreman and actually pay him $40 a week. What do you think of that? $40 for a foreman. Why, I can get foremen for $18 and $20 and they're mighty glad to get it. They're getting men's notions way up in and air and ruining the town as a place to build machinery."

Then Jackson laughed; he hadn't dared before.

"Jones, let me ask you a few questions. You're building a pretty fair grinder I suppose. No, don't sputter about it, I know it's the 'best ever' the same as every crow's young ones are the whitest, but we'll call it the very best on the market if that suits you.

"But do you think you have a right to build a grinder any better than Smith and Brown and all the rest? Men see your grinder, see how much better it is than any other and they're immediately dissatisfied with all the rest. It's a Jones grinder for them every time, if you can supply it.

"Now if Brown wants any trade he must improve his grinder; redesign it, build it better, put more and better material and labor into it, in other words he must make it as attractive as yours or you get the business. Is this fair to Smith and Brown? They've been running along comfortable like, for a good many years, customers satisfied and then you up and build a grinder that knocks the spots all out of it. Is that fair to the town or anybody else?

"And before you built this new grinder, if I remember rightly, you got a new draftsman and superintendent from somewhere or other. Of course, you didn't offer them any more money to get them to come here. Just let them know there was a chance for a good man and they immediately threw up their other job and begged to come over here for less money. I've often done the same thing myself, and I remember when we both worked in the old shop how your loyalty to the old man wouldn't let you take another job at three dollars more a week—over the left, as we boys used to say.

"Now Jones, why not look at the thing from a common-sense point of view? If you hadn't been looking out for more money you'd still be in the old shop at two-fifty per, in spite of the fact that you were paying thirty cents a pound for meat. If you hadn't jumped at the raise of three per week and kept on jumping, whenever a good chance came along, you wouldn't be building the best grinding machine on earth and riding to the shop in that red buzz wagon.

"I'm not blaming you a bit, old man, I've tried to do the same but my foresight came afterward in most cases and I'm still plugging along with the 'also rans.'

"I'm just as firm a believer in loyalty as you can possibly be, but just remember that it isn't all one sided. Money isn't everything in the world by a long ways, but it's mighty handy to have in your jeans when the rent comes due or the sixth boy needs a new pair of shoes. And a man has to think of the shoes and hats and other things when somebody tells him he is worth two or three or ten dollars more a week to them than he is getting.

"It's a pretty safe bet that the new automobile company didn't pay your men a cent more than they thought they would be worth to them. If they did, they're a different brand than you usually find and I guess I'll go over and see them myself. But if you can get a good man for $18, why worry about the man who's lucky enough to make the new company pay him forty?

"If you think it over a little I don't believe you'll think it such a crime to build a shop better than your neighbor or to pay higher wages if you think it pays. If nobody had built anything better than the other fellow, we'd all be living in caves and wearing skins and fig leaves for clothes. If the other fellow can afford to have a fine shop and pay big wages, there's a reason somewhere and it's a good plan to try and find out what it is."

Seems to me Jackson ought to turn philosopher, but from all accounts there are mighty few people waiting to pay real money for good wholesome truths along this line.

The Scleroscope in Automobile Work—I

Some Testing Problems and Standards Adopted. Mechanism of the Instrument. Proper Hardness for Different Automobile Parts. Reasons for Tests

BY ALBERT F. SHORE*

The high-wheel bicycle was a great invention because of the physical principles it involved and which set the public a thinking—it aroused a curiosity that was not in vain. Everyone said "that is not safe," nor was it. As a natural sequence someone brought out the "safety," and the skeptical public went enthusiastic, and straight away formally adopted the bicycle with a fervor that stands unique in history. The bicycle, however, was not very useful to society, and therefore, in so far as it lacked this usefulness, it died a natural death.

The automobile is much more useful than its tiny predecessor and therefore capitalists who have become interested in its manufacture need not have apprehensions for a "bicycle" reaction in the future if they make good.

In the early days of this business I was connected indirectly with the engineering and later the sales department of an Eastern motor car concern that suffered very keenly from the local gossip that would follow a breakdown. One merchant in Philadelphia who had been using a pleasure car with some success, after much annoyance caused by little troubles in the mechanism, grew enthusiastic and ordered three light motor delivery wagons—a big order 9 years ago.

Defective Gear Set

One of these had a gear set that was all right but the other two were defective and were returned. The gears employed were all case-hardened. The failure in each was in the clash gears and oddly, one was stripped while the other was so battered that the necessary engagements could not be made. This we decided to be due to using a machine steel having too high a carbon content and therefore also hardening power, while on the other hand both properties were too low.

This caused trouble in the engineering department and it was decided to import chrome-nickel steel for the gears. They were then always strong enough but very hard to work in some instances and varied widely in hardness after heat-treating. This was evident by the battering and wear that showed after some service. It then occurred to us that if the elastic limit and wearing qualities could be determined beforehand, these troubles could be overcome.

Mr. Hess, of the Hess-Bright Company, is perhaps to be credited as a pioneer in the testing of hardness in steel in this country, and he procured everything that looked promising in this line, including the only diamond-scratch sclerometer ever imported. With this it was not possible to measure many pieces except at an intolerable cost. When the scleroscope came out some years later (1907) Mr. Hess installed one and thus was the first to recognize the utility of this machine.

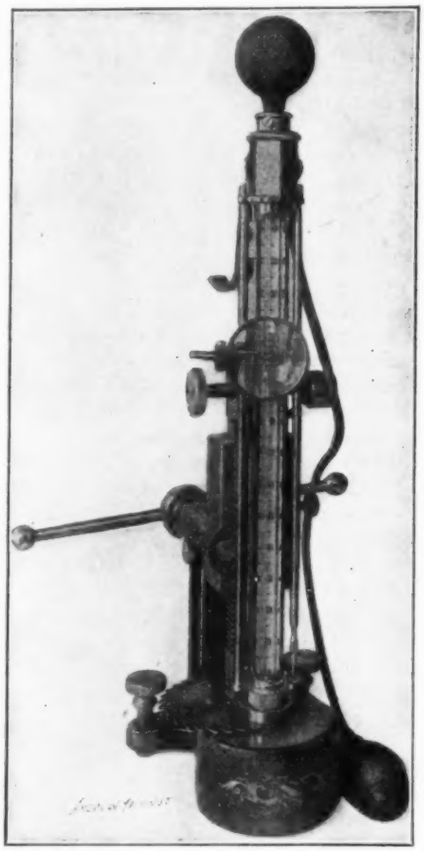


FIG. 1. THE SCLEROSCOPE

Description of Scleroscope

This machine is shown in Figs. 1 and 2. In Fig. 1 is shown the standard scleroscope with a saw located on the anvil, the teeth of which are being tested for hardness. In Fig. 2 is shown the special apparatus that is used for testing work held in a vise. This consists of a vertical shaft on which a jointed arm revolves, that holds the scleroscope at its outer extremity. With this it can be swung into any position desired and raised or lowered.

A sectional view of the mechanism of the scleroscope is shown in Fig. 3. In this the rubber bulb *A* is squeezed to draw the diamond-tipped drop hammer *B* up by suction, and it is then held by the hook *C*. To drop the hammer on the work, another bulb that is connected by a tube to the inlet *D*, as shown in Fig. 1, is squeezed. This creates an air pressure against the piston *E*, driving it against the hook lever *C*, which in turn is forced over and releases the hammer. *F* is the glass tube containing the scale.

An enlarged view of the end of the hammer is shown in Fig. 4. *G* shows the diamond set in the end of the hammer and the effect of the blow when striking a piece of tempered steel. The force exerted by this blow is 500,000 pounds per square inch. At *H* is shown the effect of the blow on a piece of soft lead that registers No. 3 hard and *I* shows the effect on a piece of hardened steel 100 hard.

Users' Experiments

The Packard Motor Car Company, whose engineers are always on the lookout for new and practical ideas, was the first to use the scleroscope for the study and standardization of motor-car material. After many experiments they installed a number of them in their various departments.

Among others, the Chadwick Engineering Company and the E. R. Thomas Motor Company have so standardized their machines that to describe them by comparison with other kinds of machines, not automobiles, would be very difficult.

Imagine a gear, yes a bunch of them, completely hidden from view, yet each being so finely tempered that in the language of ordinary machine construction, they are only second to a jewel in a watch. These have a hardness that depends on the distinct function of each. The hardest may measure 88 by the scleroscope. But what can this be compared to?

Comparisons of Hardness

A saw hard enough to cut an iron pipe in two, without getting dull, must be at least 75 hard. Many powerful dies and tools tempered for cutting steel run from 85 to 100 hard, and thus it can be seen that the hardness of some of these gears is equal to the finest cutting tools. But this is not all. Ordinary tool steel is only hard, but not very strong; automobile steel must be both, and its strength is from 100 to 200 per cent. greater. To be exact, tool steel when average fine and properly hardened has a strength at this

*President Shore Instrument and Manufacturing Company, New York, manufacturers of the scleroscope.

temper of about 100,000 pounds per square inch, while that of vanadium or chrome-nickel steel also properly tempered will show an ultimate strength of from 200,000 to 300,000 pounds per square inch.

Conditions for Which Standards Were Adopted

The hardness standards here listed were recommended originally by practical engineers of the above-mentioned firms, after taking into consideration the exact character of the functions of each part. Some of the figures were more or less arbitrary, but much labor and expense was involved in experimentation before their final adoption and they were then kindly contributed for this article. A number of cars were fitted up with similar parts which differed in hardness and all were put out under severe and trying service for months.

FIG. 2. TESTING BEVEL-GEARS FOR HARDNESS

These were then disassembled and all parts cleaned and carefully studied for the following shortcomings:

1. Battering and shearing of parts due to being too soft in the interior when case-hardened, or when hardened without cementation, or without hardening at all.
2. Wear due to lack of hardness.
3. Chipping of corners due to over-hardness.
4. Fatigue due to an elastic limit and hardness that was too low.
5. Crystallization and failure or fractures owing to excessive hardness, lack of toughness, or both.

Conclusions Drawn from Experiments

At the close of these trials which were carried on simultaneously but independently by a number of manufacturers, it was not only found that certain degrees of hardnesses were most suitable for certain parts, but that some alloys were preferable.

Referring to condition No. 1 it developed that a 5 per cent. nickel steel used for case-hardening was not superior to crucible, or even open-hearth mild steel, having a low phosphorus content and no nickel at all. The trouble here was the failure to harden up to the standard after cementation with the results noted in condition 1 as well as in 2.

Condition No. 3 is very common in almost any kind of hardening steel, which must all be watched, although chrome-nickel steel, when of a composition to best facilitate forging and working, commonly fails to come up to the standard of hardness.

Condition No. 4 is usually due to inferior steel or other metal which is not tough enough, or in other words is too brittle or short-fibered when hard enough, or too soft when not brittle.

Condition No. 5 will be manifest in almost any steel when too hard and subjected to torsional or bending stresses, but much less so in some of the high-grade special steels.

Hardness Number Adopted for Different Parts

After having thus selected the proper material, the following hardness numbers have been adopted:

Frames. Chrome-nickel steel oil treated, 40 hard.

Axles: Ditto (35 carbon). This hardness is equal to unannealed carbon-tool steel quite too hard to work with ordinary cutting tools.

Springs: (Hardness not yet standardized) excellent results from 60 to 70, when using vanadium steel. Good piano wire shows 70 hard, a tool-steel spring shows 80 to 85 hard in comparison.

Crank shafts, of 0.35 carbon, chrome-nickel steel heat-treated, 45 to 55 hard. This represents an elastic limit of about 110,000 pounds per square inch. When the hardness drops to 40, the elastic limit is much lower and they wear out very fast. It is believed that instead of having the limit 55 it may be 65 in the future, but this is still a matter under observation.

Transmission shaft (square), 50 to 55 hard when of chrome-nickel steel.

Transmission gears, of chrome-nickel steel from 80 to 88 hard. Of nickel steel, 70 to 80. This latter is because chrome-nickel steel is tougher at a high hardness than nickel steel. In gears carrying an equal load and which have the same tooth surface those which remain in a fixed engagement may be somewhat softer than those which are subject to duties additional to wear, each as the change or clash gears. Thus when 60 hard may give good service in a bevel gear the same hardness in a clash gear would cause failure by becoming battered and worn. Likewise continuous-running gears would not be so apt to suffer if their hardness run somewhat above the standard. The standard for clash gears is thus 85, when using chrome-nickel steel, and 80 for bevel gears. Some gears, such as the small differential, which are but lightly used, and need not resist wear so much, are strong enough if only 40 hard, but 60 to 70 is better.

Starting crank shaft, 60 hard.

Pump shaft, 70 to 80 hard.

Piston pins, cold-drawn steel tubing, case-hardened, 85 to 100 hard.

Steering brackets, 90 hard.

Steering balls, 55 to 75, depending on the size in relation to strains imposed.

Spring seats, 60 to 70 hard.

Main countershaft washer, 80 hard.

Valve lifter roller pin, 60 to 65 hard.

Clutch-shaft gear, 70 to 80 hard.

Exhaust cams, 85 hard.

Valve lifter roller, 85 to 100 hard.

Coups, 60 hard.

Inlet cams, 85 hard.

Clutch shafts, 80 hard.

Fan cones, 70 to 75 hard.

Ball rings, 85 hard.

Low-speed bevel, pinion and countershaft for transmission, when made in one piece of chrome nickel, are 82 for gear and 70 for shaft.

Valves, 50 to 60 hard.

Cam shafts, 80 to 90 hard.

Steering worm, 70 to 80 hard.

Thrust and ball-bearing rings, 80 to 90 hard.

Engine-valve plungers, 90 to 100.

Cones, 70 to 80 hard.

Keys hardened, 75 to 80 hard.

Nuts (special hardened), 90 to 100 hard.

Dowel pins (heat-treated), 50 to 75 hard.

Screws and bolts (all), 40 to 50 hard.

Ordinary screws and bolts are 18 to 30 hard.

Comparisons: Brass castings (soft), 7 hard; wrought iron, 18 hard; machinery steel, 25 hard; annealed steel, 30 hard; gray-iron cast, 38 hard; hardened tool steel, 100 hard.

Reasons for Hardness Tests

A glance at the list of hardness standards given, and a few moments of reflection after comparing them with the materials last listed and of which ordinary machines are constructed and give good service, will give the reader some idea of what there is in a first-class automobile that makes it cost and endure abuses.

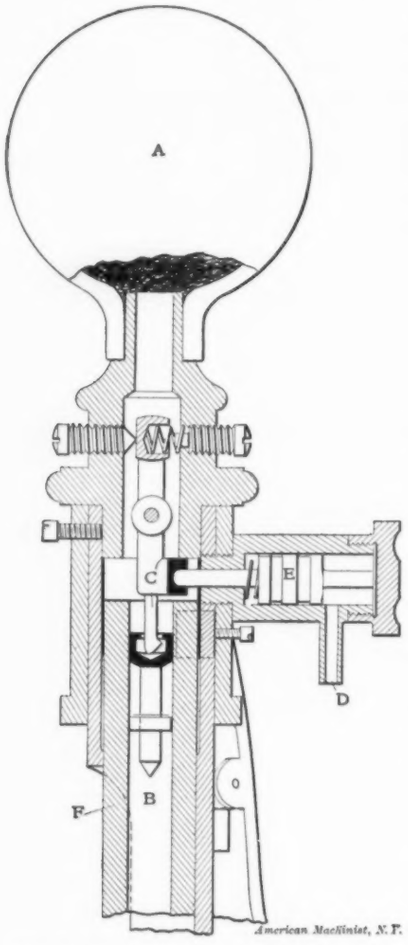


FIG. 3. SECTIONAL VIEW OF SCLEROSCOPE MECHANISM

With the exception of some of the parts which must positively be hardened in any kind of machine, as for example the clash gears, it is not really necessary that all be heat-treated to a standard hardness so long as size and weight enough are allowed to make up for the difference. Thus a set of chrome-nickel steel gears, weighing say 5 pounds and 85 hard, when made of machinery steel would have to weigh nearly 20 pounds, to say nothing of the extra friction caused by so large a surface and the fact that being soft they would never become burnished and smooth after service and thus present a good wearing surface.

This condition shows very clearly that there is more than one reason why responsible manufacturers do not hesitate to go to great expense in gathering together the best that metallurgy and science have to offer. At best, the automobile is a machine that is too heavy. Excessive weight is very hard on the tires and every ounce that is not absolutely necessary adds to the gasolene bills.

In dealing with heat-treated or hardened and tempered parts that find their way into the modern auto, many distressing losses occur due to variations in the steel used and its not coming up to the standard when tested, or due to warping and cracking in the hardening. Then, of course, steel thus treated cannot be readily machined, and must be ground true to size.

Why Expensive Machines Are Made

The public demands that so great and useful a commodity as the perfected motor car be brought within the reach of the greatest number, and, of course, this naturally can only be accomplished by cutting down the price, which is being done by manufacturing in large quantities.

Like in the days of the bicycle cheap parts are being turned out, and assembled, that are liable to cause the loss of life and limb. This condition of abuse is inevitable, but it is well recognized, and, fortunately, combatted by the several automobile associations of this country and Europe. These bodies employ skilled engineers to guide their manufacturing members and to enhance the popularity of the automobile by giving the public full satisfaction at all times.

This is done in primarily four ways, i.e., by the diffusion of metallurgical knowledge, liberal testing, simplicity of construction, and guarding against the unscrupulous who turn out machines unsafe to life and limb.

High-grade automobiles are not made of hardened and tempered steel merely to outlast a cheaper machine; the capital issue is absolute reliability under the most trying circumstances of rough usage and when a slight failure may kill and maim a whole family or group of people.

Passing of Old Fallacies

But a few years ago many engineers felt perfectly secure when the materials used for construction showed under test that the ductility or elongation was up to the specifications, the hardness being so little understood in the absence of suitable measuring apparatus that it was pardonable to neglect this factor altogether.

In the most notable and disastrous failure, that of the giant Quebec cantilever bridge, the workmen saw one of the compression members begin to buckle due to the stretch and final shearing of the very ductile rivets. Need we wonder then, why bolts and screws, insignificant as they seem, are actually made of tempered steel for automobiles. This is to prevent their being sheared off by transverse strains, or their becoming loose by permanent stretching under strain.

It was formerly thought that if an axle were soft enough it would not become fatigued so rapidly and would therefore resist crystallization and fracture longer; this was also true with springs and other parts. Wrought iron has thus been found to be on the average safer than mild steel at its worst, which shows that the principle was sound, but only under certain conditions.

What is actually needed is a metal that has the two great properties which ordinarily are not compatible, i.e., a very high elastic limit and also ductility. This spells toughness, such as only the alloy steels possess. The softer a steel is, the more ductile it is, and the lower the elastic limit. The harder the steel is, the higher the elastic limit and the more brittle it becomes ordinarly.

Properties of Alloy Steels

The object of such alloy steels as chrome-nickel, chrome-vanadium, nickel steel, etc., is to produce a metal that can be hardened to a point where it will resist wear, will also have a very high elastic limit, to resist stresses, and yet show a certain amount of ductility or elongation when the said elastic limit is exceeded. The safe and strong steel of the present day is therefore one whose elastic limit is as far beyond the greatest strains imposed as possible.

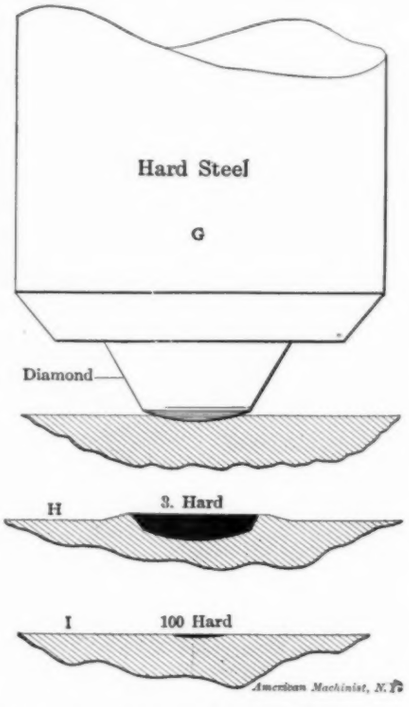


FIG. 4. MAGNIFIED VIEW OF DROP HAMMER

To illustrate what the non-observance

of these contingencies may mean in actual practice the following is an example. In breakdown tests for the dynamic life of vanadium axle steel, Stead got 67,500 rotary vibrations, while Southers got 100,000,000 without any signs of failure. This acute difference may be due to the former approaching the elastic limit close enough to cause crystallization or fatigue, while the latter, using the same angle of flexure, remained enough within the elastic limit so that practically no change took place and therefore no failure was possible.

If a spring were made up of leaves of the proper hardness, except one that was too soft, and then it were used roughly, as by bending the maximum number of degrees, the soft one would fail in the shortest time, because its elastic limit is too low to bend so many degrees without permanent set. Likewise if the hardness were great enough to approach brittleness then, like in the softer one, crystallization would soon cause fracture. Hence these facts show that if the greatest factors of safety are desired, the line betwixt and between becomes so narrow that our only salvation is testing liberally, and with the means thus at hand it is criminal to neglect the obligation.

(*To be concluded.*)

Aviation

By J. Richards

"From the 'Clermont' grew the 'Lusitania' of today."

This quotation, from a prominent newspaper, expresses tersely the popular opinion of the day, respecting navigation of the air, or, as it is euphonically called, "aviation."

This is the "popular" idea; but there is another view, entertained by a more thinking class of people, that needs some promulgation at this time to save the wrecking of hopes, not to mention the fortunes of many sanguine people and it is a good time to revert to a technical and scientific view for some practical ideas on the subject.

To begin with, not one in twenty sees the true "inwardness" of modern aviation, and fewer still recognize in it a thermodynamic problem, one of motive power and dividing of horsepower into the weight of motive apparatus. This is the true secret, and the *crux* of the whole—on which rests what has recently been attained in aviation. It is a sordid view, but wholesome.

Dr. Lardner—a man eminent in what we may call "popular science"—fifty or more years ago, said in a lecture, commercial traffic across the Atlantic by means of steam was impossible; and it is common to cite Dr. Lardner's *dictum* as an example of the failure of scientific reasoning, in respect to enterprises resting on physical laws. The quotation at the beginning is a reflex of this taunt, but Dr. Lardner was right, from the premises at his command.

He was not a constructing engineer, nor was there any such broadcast information then, as now, on the relation between heat and energy. There were no successful heat engines, except those operated by steam, and heat had no proved dynamic equivalent—a theme now elementary and dealt with by school boys. At Dr. Lardner's time it required five pounds of coal to perform what one pound does now, and this is the secret and difference—also the further difference, that horsepower into weight has taken away one-half the dead load of steam apparatus since his time.

Balloons have been invented a century, or, indeed, required but little inventing. The buoyancy of water was familiar always, and the discovery was of attenuated gas being lighter than air. The rest followed down, until the light motor gave us propulsion and the "dirigible" balloon. Discoveries were in an impervious covering for the gas-bags, their frame-work and rigging; but there was no reason to navigate the air—at least none commensurate with the expense and risk. "No one wanted to go that way," except for scientific observation.

Commercially considered, a balloon for transport may be called an absurdity. The main feature and function is sustension, or buoyancy—not at all required in moving traffic on land. Air at 60 degrees of temperature weighs about 0.075 pound per cubic foot. Hydrogen has a gravity of 0.07; so the buoyancy or sustaining power of 1000 cubic feet of the latter can float about 70 pounds—which must be reduced one-half, for the confining vessel and its gear—so we may reckon 35 pounds to 1000 cubic feet of contents, and this is merely sustension without propulsion. No one wants to buy transportation at this rate—leaving out the novelty and danger.

Since the Montgolfier balloons of 1783 to the Andrè in 1897 (more than 100 years), and with the efforts of many skilled men balloons remained practically the same, because no useful economic result could be attained.

Then came the "concentrated" motive engines, that have added the feature of propulsion and dirigibility, in some degree, and given the balloon a new, but slight adaptation to human wants, if we except this questionable adaptation as an instrument of offense in the aid of destruction—of which we have quite enough now. This phase of the subjest is well disposed of by an adage one sometimes hears in Sweden: "Killing people proves nothing."

The development of high-speed hydrocarbon motors has produced the aëroplane now the rage. It proves that one of these motors can, by a correctly disposed plane, of light construction, lift itself in the air and a small weight beside, and travel at a high rate of speed—indeed it must do so as speed is the main factor in sustension. "But what of it?" one may inquire. Again "Who wants to go that way?" or rather, "What are the objects of going, like Blériot, from Calais to Dover, or anywhere else on an aëroplane.

Translations of thought and speech are instantaneous, by telegraph, and speed of conveyance over the land is now as great as can be attained by aëroplanes. The atmospheric resistance is no less than for a railway train and the sustension of the load—costing most of the motive power—is almost a dead loss, when compared with rolling friction of a railway train; so the ultimate utility of the aëroplane must be in carrying despatches across narrow waters or in otherwise inaccessible places.

Some years ago, Hiram Maxim took up the subject of aviation, and with consummate skill devised a steam-engine—then the ultimate in light weight— and attempted to raise an aëroplane with it. The structure was of the usual contrivance—of oblique surfaces, with large area, supported by light wires and framing—but we imagine this part of the scheme was subordinate to a motive power that would lift itself in the air; and his attention was, no doubt, mainly directed to such an end.

He demonstrated the possibilities of such a motor, and dropped the subject—which is significant. Professor Langley, too, with his elaborate theories of aërial currents, and theory of soaring, did not discover that the real problem was horsepower divided into weight, with which, of course, there were experimental conditions of balancing and the like; but no one (not even Mr. Chanute) treated the subject as one of dynamic nature.

Out of the whole art of aëronautics, there is no hope or promise that need much concern practical people, looking to permanently useful results in travel or transportation.

The air, as a buoyant agent, will remain the same, at 3 grains a cubic foot; and if some more efficient power, to raise aëroplanes, is discovered—capable of raising greater loads—the art may continue an amusement, no doubt, but without any definite economic value. The following remarks are attributed to Orville Wright in answer to a query as to the possibility of aëroplane transport, and if he thought it possible.

"Never, in my opinion," Wright answered with conviction. "I do not think there is any likelihood whatever of flying superseding present means of locomotion by rail and steamship, because it is too expensive and dangerous. A bird expends much more force in flying than animals do in walking on the earth. It is the same way with flying machines. In proportion to their weight, they require much greater power than it takes to draw a train along the rails. An aëroplane might be cheaper to make a trip in, than a special train chartered by one man, but for ordinary commercial use it cannot compete with the steam engine."

Jig for Boring a Bearing in the Drill Press

By M. E. Dawson

An interesting drill-press job and the jig and tools required to do the work are shown in the sketches, Figs. 1, 2 and 3. Before this jig was made the machining was done in a boring mill, the larger frame being done with a boring bar in the drill press; but this method was too slow. It also required the services of a practical machinist.

The pieces to be machined are cast iron and cast steel and are of the A-frame design. They not only have the large bearing at the top which is machined in this jig, but also carry part of the driving machinery; for this reason the chucking is very important. These frames vary in hight from 2 feet to 4 feet 8½ inches and the diameter of the drilled holes from 1 15/16 to 3⅛ inches. The lengths of the hubs are from 6 to 13⅛ inches. There are 12 frames varying in weight from 228 pounds to 750 pounds. The jig will take care of any one of these frames regardless of the length of the hub or hight of frame and when the diameter of the hole calls for a change of guide bushing this change can be made in 5 minutes by simply removing the bushing plate and substituting the one required.

Construction of the Jig

A is the cast-iron frame that is to be drilled. *B* is a cast-iron plate machined on the bottom; on the top are cast the three lugs *C*, the hubs *D* and *E E*, and the vertical plate *F*. *G* is a steel chucking ring, and *H H H* are chucking or centering pins.

After machining the bottom of plate *B* it is chucked in the lathe or boring mill and the parts *C*, *D* and *E* are turned as shown to receive the ring *G*. Pins *H* are machine steel, 1½ inches diameter; the inner ends are hardened, and the outer end has a milled slot ⅝ inch wide, also a hole for pin *J*. Brackets *D D D* are drilled to receive pins *H*. *E E* are long hubs having drilled holes into which are inserted the guide pins *I*, which are 1⅝ inches diameter and are secured by set screws in *E*. *F* is a vertical plate planed to receive angle plate *X* which has two slotted holes to allow for vertical adjustment; it is bolted to *F* and serves two purposes, acting as a gage and support for the top end of frame *A* and also as a protection to the steel ring *G*.

The ring *G* is finished all over and the inside is made a sliding fit over *D*, *C* and *E*. It has three slots ⅝x5⅛ inches long cut out so as to give 1-inch movement to the pins *H*. Pins *I* in the centering pins *H* are ¾ inch diameter and on these pins are hardened rollers that fit in the cam slots. *K* is a cast-iron plate for holding the drill bushing. The largest size bushing is put in first, and all the others are made to fit inside of it.

Handling the Jig and the Work

Hubs *L L* are drilled and reamed to fit over pins *I I*, which are not the same length; so to remove the work after it is finished it is only necessary to lift the plate *K* above the short pin and swing it around out of the way, the long pin acting as a pivot.

The jig rests on and is secured to two I-beams which form a part of the jig and from which it is never removed. The I-beams, as shown in Fig. 2, are clamped to the base of the drill press; they are long enough to allow another I-beam *M* to be placed across the top to support the outer end of the A-frame.

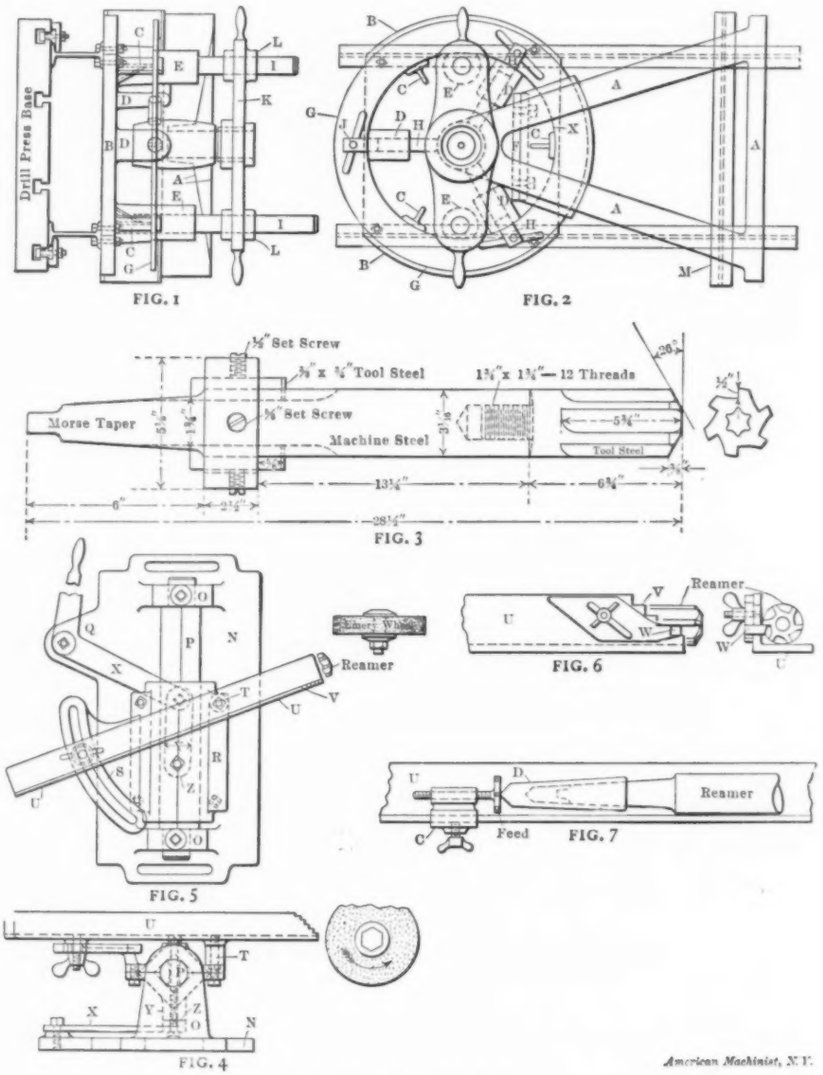
The setting of the chuck, also the handling of the work, are all done with an air hoist. The largest frame can be chucked and machined to a finish in 45 minutes. The hole when finished measures 3⅛ inches diameter by 13⅛ inches long, 3/16 inch stock on a side being removed from a cored hole.

The Tools Used for Finishing the Hole

Fig. 3 is a sketch of the special tool used to drill the holes in the frames. The body and taper shank are one piece of machine steel, the end is drilled and tapped for 1¾x1¾ 12-thread stud. The cutting end is made from "Blue Chip" steel and has 6 flutes 5¾ inches long with a backing clearance of about 2 thousandths. The cutting face is beveled at about 26 degrees which from experience proved to be about correct. The other end has a threaded stud which is a snug fit in the body. Some of these are made, as in sketch, with a pair of face mills for facing the ends of the bearing hub without removing from the jig. With this drill the large hole can be drilled and finished in "one time through," leaving an accurate hole.

Grinding Fixture

A special grinding fixture is shown in Figs. 4, 5, 6 and 7 for grinding the ends of drills shown in Fig. 3. Base plate *N*, trunnion stands *O O* and projecting arm *Q* are cast in one piece. *P* is a square piece



THE JIG AND THE TOOLS

2¼x2¼ inches, having turned ends that fit in the bearings *O O*. *R* is a sliding piece ported through the center and machined to a snug sliding fit on shaft *P*. On the upper half of *R* is cast the fulcrum hub *T*, also the wing *S* which has a slot cored through. *U* is a cast-iron right-angle piece having two bosses, one at *T*, the other at the center of the curved opening in *S*. This piece is machined all over. The end at *V*, Fig. 6, is stepped. At the side is shown a plate having a slot, also a projecting lip at *W*; this plate is secured to *U* by a stud and winged nut. *Y* is a connecting link, one end of which is hooked to boss *Z* at the bottom of *R*, the other end to the lever *X*. At *T*, which is the fulcrum for angle-iron *U*, is a taper head bolt in a countersunk hole in *U*, which is secured by a nut at the bottom. A stud in *U* passing through the slot in *S* is provided with a winged nut which clamps *U* at any position on *S*.

The lip *W* rests on the step *V* (Fig. 6) and on the top of this lip rests the lip of the drill when being ground. The position of *W* is determined by the diameter of the drill.

Holding and Adjusting the Drill

In Fig. 7 is shown a simple device for rapid changing to the various lengths of drills, also a simple feeding device. The drill shanks are all made to the Morse taper. Very often careless workmen batter up the ends of the shanks so that it is unwise to use these ends as a gage, particularly when grinding. To insure accuracy an extra sleeve was made as at *D* to fit over the standard shank, the end of this being hardened to guard against damage. *C* is a stop which slides back and forth on the vertical side of *U* and is secured by a winged nut, it is provided with a threaded hole to receive the stop screw which has a disk head with holes in its edge to provide for feeding the drill up to the emery wheel.

The drill fixture is secured to the top of a wooden table and a small emery frame secured in about the position shown. The drill is placed in the angle *U*, as in Fig. 6, and by means of the lever *X* it is moved back and forth past the emery wheel; thus the ends of these heavy drills are accurately ground.

Bearing *O* is capped, but unlike other bearings of this kind the clamping is done by a stud, passing through a slotted hole in the trunnion ends of square shaft *P*, then through a hole in the cap, and clamped by a nut as shown. By releasing the nuts on *O* the shaft *P* may be tilted so as to give the desired clearance to the bottom of the drill, while the slotted opening in *S* takes care of the taper on the end face of the drill. The slots at either ends of base *N* provide a means for bolting the frame to the table. It makes no difference what the diameter or length of the drill is, this jig can be changed in an instant to do the grinding and do it correctly.

The Disk Method of Locating Holes Accurately

Our readers will recall that some time ago in the articles presented in these columns on accurate tool work, one of the schemes illustrated was that known as the disk method, which involves the use of, say, three disks placed in contact with one another, each disk then being used as a means for indicating and centering the work before the boring out of the holes.

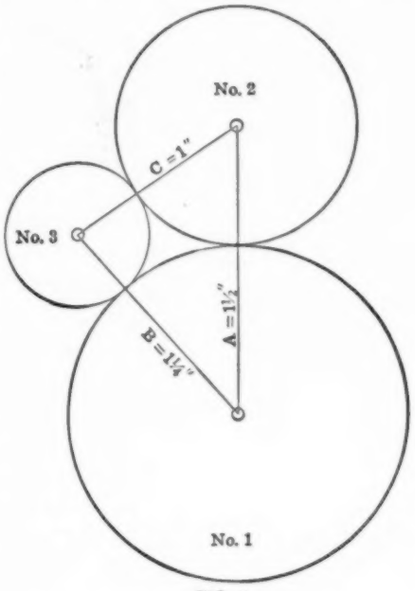


FIG. 1

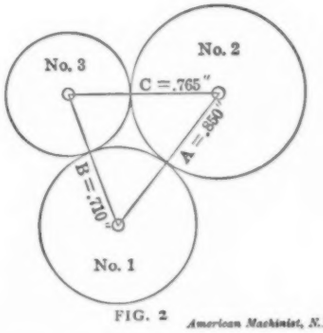


FIG. 2 *American Machinist, N.Y.*

FINDING SIZES OF DISK FOR LOCATING HOLES ACCURATELY IN TOOL WORK

This method, of course, means that the diameters of the disks must be very accurately determined in order that the center distances between the holes shall be correctly located. In connection with the publication of this disk method, a set of simple equations were presented for finding the sizes of the three disks to conform to any given distances between centers.

Professor Sweet has just sent in to us a simple arithmetical solution of this disk problem which cannot fail to appeal to all toolmakers and others who are interested in following up means and methods of doing nice work. Considering, for example, Fig. 1, where we have three center distances given, as 1½, 1¼ and 1 inch, respectively, what sizes shall we make the three disks in order that when brought into contact with each other as shown, their centers shall be exactly the specified distance apart? It is obvious upon inspection of Fig. 1 that distance *A*, being ¼ inch longer than distance *B*, the radius of disk No. 2 must necessarily be ¼ inch longer than the radius of disk No. 3. Then, as center distance *C* equals 1 inch, and as radius of disk No. 2 must be ¼ inch longer than that of No. 3, the 1-inch line must be divided into two parts, one of which shall be ¼ inch longer than the other; that is, for the 1-inch line, dividing by 2 gives us ½ inch, and adding and subtracting from this one-half of the difference between the two radii, that is, ½ of ¼, or ⅛ inch, we have as the length of the radius No. 2, ⅝ inch and for radius No. 3, ⅜ inch. If we subtract ⅝ inch from 1½ inches, the length of line *A*, it will leave us as the radius of disk No. 1 a length of ⅞ inch; or, to test this on line *B*, subtract ⅜ inch from 1¼ inches, and we again have ⅞ inch.

Let us consider another case as illustrated in Fig. 2. Here we have the three center distances *A*, *B*, *C*, given as 0.850, 0.710 and 0.765 inch, respectively, and subtracting *B* from *A* we have left 0.140 inch, which represents the difference between the radius of disk No. 2 and the radius of disk No. 3. As in the preceding problem, we must now divide line *C* into two parts and the difference in the length of these two parts must be 0.140 inch. We first divide 0.765 by 2, giving 0.3825 inch, and from this subtract half of the difference required; that is, half of 0.140, equal to 0.070, leaving 0.3125 inch as the radius for disk No. 3. Adding 0.070 to 0.3825 then gives us 0.4525 inch as the radius of disk No. 2. Subtracting 0.4525 from the total length of line *A* or 0.850, we have 0.3975 inch as the radius of disk No. 1; or, subtracting 0.3125 from line *B*, which is 0.710 inch, we have 0.3975 as before for the radius of disk No. 1.

The question of swelling of cast iron from repeated heating and cooling has been made the subject of investigation on several occasions, and a report of tests recently made in Manchester, England, by Professors Rugan and Carpenter gives as the conclusions of the investigators that the action of air, fire gases and even the gases occluded in the metal, sets up the formation of compounds of silicon with the gases, and in this way causes the expansion. The volume-increase is always accompanied by an increase in weight, but the latter is much smaller than the increase in volume. Tests in a series of samples having constant carbon showed that the graphitic carbon is not primarily concerned but that silicon is responsible, the expansion being proportional to the silicon percentage.

Fusion Welding Apparatus and Work

Multiple Generation of Oxygen and Acetylene. Hydraulic Pressure Control. New Blow-pipe. Some Difficult Jobs That Were Done

BY E. F. LAKE

The welding of metals together by means of gases that heat them to the point of melting, thereby fusing the two parts together, has proved itself to be so useful and practical that the users of this process are constantly increasing in number. This has been the means of many improvements being made in the apparatus, which facilitate the work done by the blowpipe or torch, and simplify and make more constant the generation of the different gases used.

The Oxy-Carbi Company, of New Haven, Conn., has developed some new things along this line in the way of continuous generation of oxygen and acetylene, hydraulic-pressure control of the acetylene, and a new design of blowpipe that seem to be an improvement over some of the older apparatus.

Portable Welding Outfit

In Fig. 1 is shown the portable welding outfit that this company makes, and as will be seen, the oxygen and acetylene gases are generated on a truck, by means of which it can be moved to the work that it is desirous of doing. In the front of the truck will be seen the two generators, in which the oxygen is generated from black oxide of manganese and chloride of potash. It then passes into the tank immediately behind it, inside of which is the scrubber for cleaning the gas. The acetylene is automatically generated from the calcium carbide in the rear tank. The blowpipe that uses these two gases, in welding, is connected to the rubber hose, shown on the side.

This apparatus is about 30 inches wide, 72 inches long, and 70 inches high over all, so that it is not very bulky, and one man can wheel it to any part of the shop in which it is required for welding. The inside of the shop, however, is not the limit of its field, as it can be taken nearly anywhere outside the shop as well.

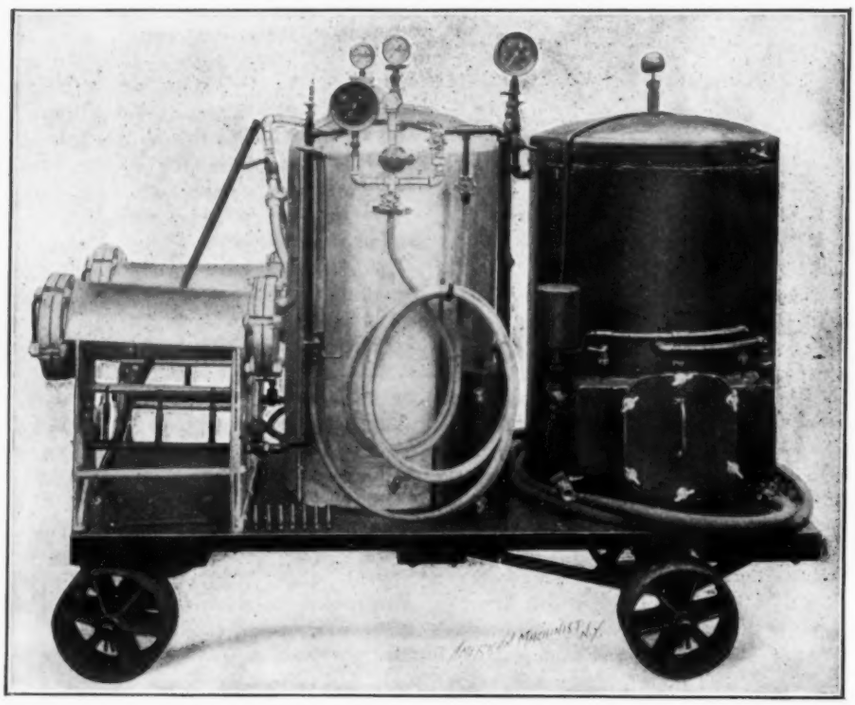


FIG. 1. OXY-CARBI COMPANY'S PORTABLE OXY-ACETYLENE WELDING OUTFIT

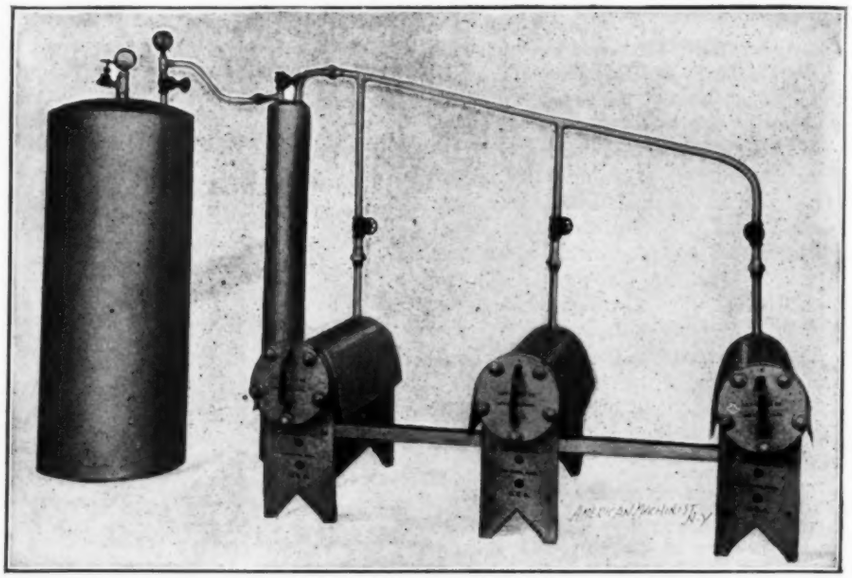


FIG. 2. CONTINUOUS OXYGEN GENERATOR AND STORAGE TANK

Oxygen Generation

In Fig. 2 is shown a stationary oxygen-generating outfit that illustrates the continuous generation of oxygen adopted by this company. As will be seen, to the right of the tank there are three retorts in which the chemicals are placed for the generation of the oxygen. Underneath these gas jets are burned until the chemicals reach the proper heat to give off their oxygen in the form of gas, which goes out through the pipe into the scrubber and from there into the storage tank, shown at the extreme left.

By using three generators one can be generating gas while the next one is cooling off from its former charge and a third one is being cleaned from the old charge and refilled with a new one. As many of these generators can, of course, be used as are needed to keep the volume of gas going into the storage tank equal to that which is being drawn out by the torches for the welding or cutting of metals.

Acetylene Generation

In Fig. 3 is shown a stationary plant for the continuous generation of acetylene. In the center is the storage tank, while at each side of it are two generators, and

to the left the scrubber. As with the oxygen generators, one of the two acetylene generators can be cleaned and refilled while the other is working, thus keeping a continuous supply of acetylene in the tank, as with the oxygen apparatus.

This outfit is also supplied with four carbide holders or generators, and these can be added to if desired, so that it can be made to supply any number of blowpipes, of any size, with a high quality of gas without the pipe or torches overheating or clogging. It can consequently be run day and night for an indefinite period.

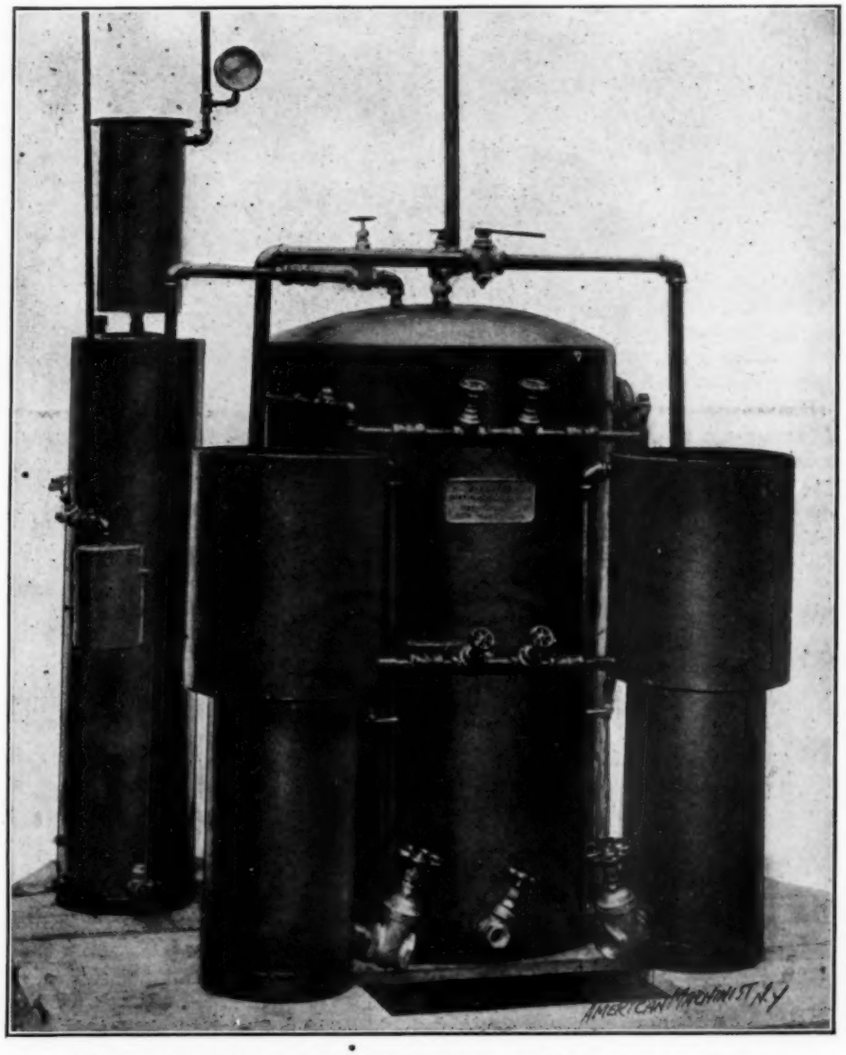


FIG. 3. CONTINUOUS ACETYLENE GENERATOR, STORAGE TANK AND SCRUBBER

In Fig. 4 is shown the same apparatus as that in Fig. 3, with the exception that it has added to it a hydraulic pressure regulator. The details of this apparatus are shown in Fig. 5 with the work that each part performs. With this the acetylene pressure can be set at any desired number of pounds that the work which the torch is doing demands, and it will then be kept constant at this pressure.

Welding Torch

In Figs. 6, 7 and 8 are shown the welding and cutting torches, in which several new principles have been adopted. At *A A*, Fig. 6, are the valves that admit the oxygen and acetylene gases, the oxygen going through the upper pipe and the acetylene through the lower. The oxygen is admitted through a comparatively large pipe, in the front end of which extends a smaller pipe for some distance, as shown at *B*. This allows the incoming gases to form a cushion in the space surrounding the smaller pipe and pass through the small pipe at a more constant pressure. The welding and cutting torches only differ in the front end or head. Fig. 7 shows the construction of the welding torch, while Fig. 8 shows that of the cutting torch.

The oxygen pipe is connected to the head by means of a stuffing box, as shown at *C*, so there can be no leakage. The oxygen passes from there down through the small, central hole in the hexagonal-shaped flat piece *D*. The acetylene coming through the lower pipe fills the passage surrounding the nipple *E*, and then passes through the small holes that are drilled on a bevel in the piece *D* and mix in the chamber *F*. From there they pass out through the opening in the end of the torch.

The piece *D* is made interchangeable to suit different-sized nozzles, and a number are supplied that have different-sized central holes to admit the correct volume of oxygen into the mixing chamber, and they also have a different number of beveled holes drilled on a circle to admit the volume of acetylene that will deliver the proper mixture of gases to the torch.

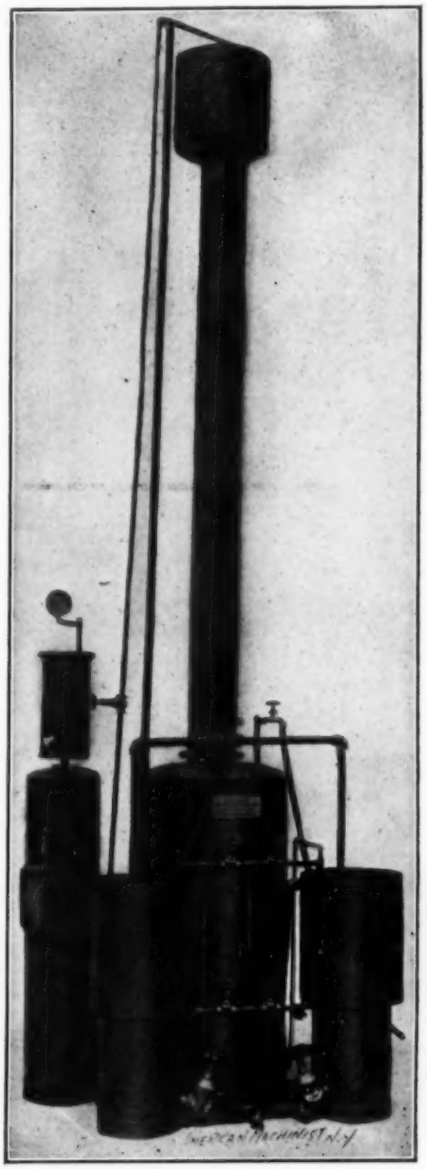


FIG. 4. ACETYLENE GENERATOR WITH HYDRAULIC PRESSURE REGULATOR

The smallest of these have three acetylene holes and the larger 4, 5, 6, etc. When a different-sized flame is required, all that is necessary is to put the correct piece *D* in the proper nozzle and screw this into the torch as far as it will go. The flat piece *D* will then seat itself on the nipple *E*, as shown.

The acetylene inlet is made by putting 16 small pipes inside of a larger one. This is done to prevent a flash back, as the

holes in the 16 small pipes and the spaces between them are so small that a flame will not pass back through their entire length. This does away with the necessity of screens that are liable to clog, and makes a very light torch for the operator to handle.

Cutting Torch

The cutting torch differs from all others by not having an extra pipe to supply the extra stream of oxygen that is required when cutting. Its construction is as follows: The oxygen comes through the passage *G*, Fig. 8, which is larger than the passage *H*, so that a portion of it will pass through the holes *I I* to mix with the acetylene for the flame, while the balance passes through the passage *H*, which is the center of the nozzle, to form the extra blast of oxygen. The acetylene comes into the chamber *J* that surrounds the cone *K*, which is perforated with small holes, as shown at *L L*. It then goes through these small holes into the chamber *M*, where it meets the oxygen coming through the holes *I I*, and the two gases are mixed. From there the mixed gas comes out at the opening *O*, where it is burned for heating the metal to the point of oxidization so the extra blast of oxygen can force it out of the kerf.

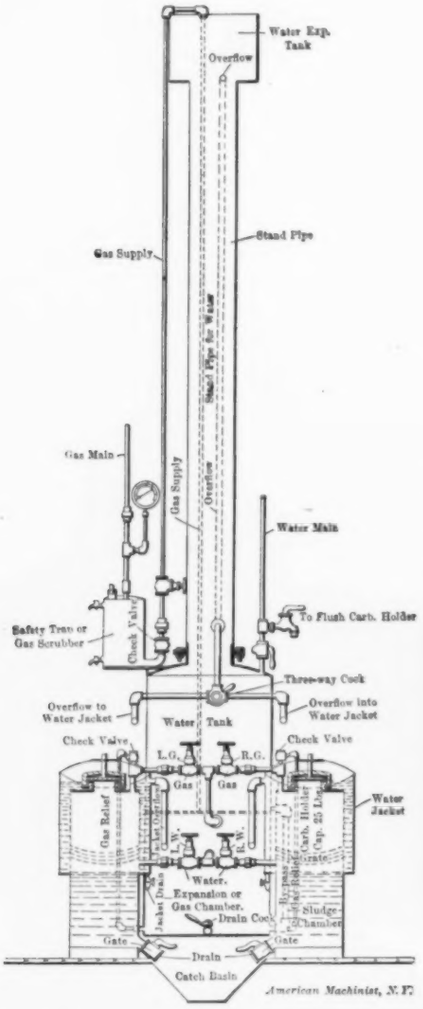
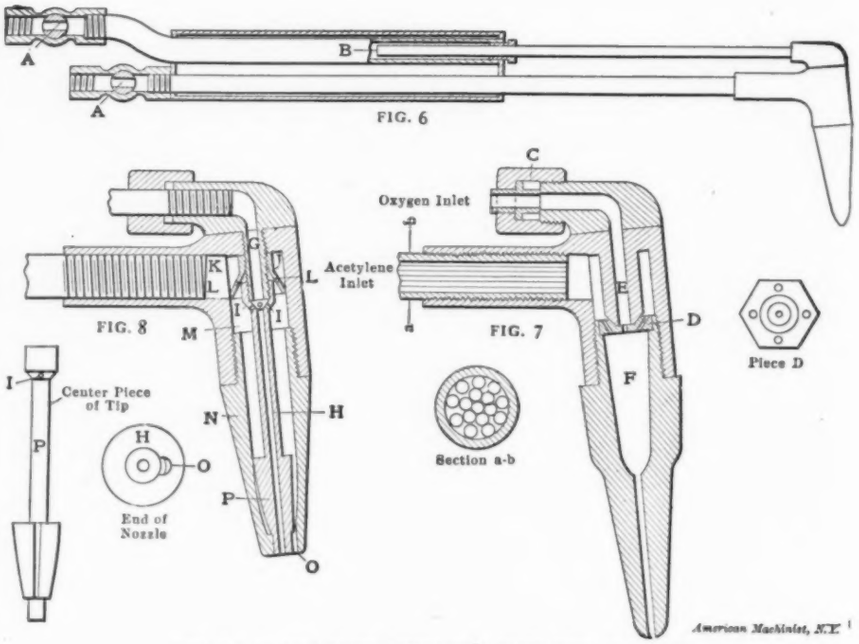


FIG. 5. DETAILS OF ACETYLENE GENERATOR WITH HYDRAULIC PRESSURE REGULATOR



DETAILS OF OXY-CARBI COMPANY'S BLOW-PIPE OR TORCH

In Fig. 9 is shown the cutting and welding torches with the extra tips that are supplied with each. The upper one is the cutting torch and the lower the torch for welding.

Welding Automobile Parts

Some of the interesting work that has been done with this apparatus is shown in

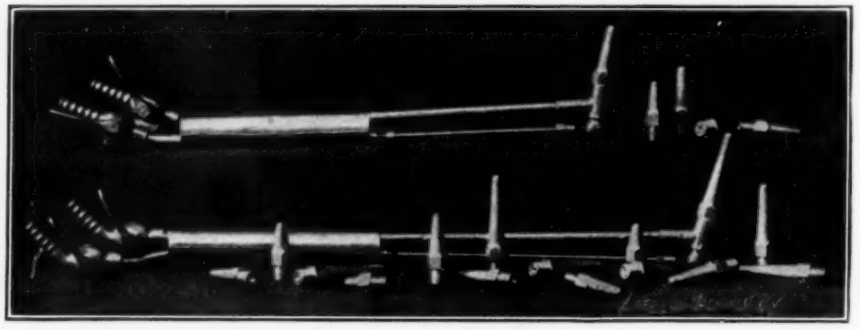


FIG. 9. CUTTING AND WELDING TORCHES WITH THE EXTRA TIP SUPPLIED

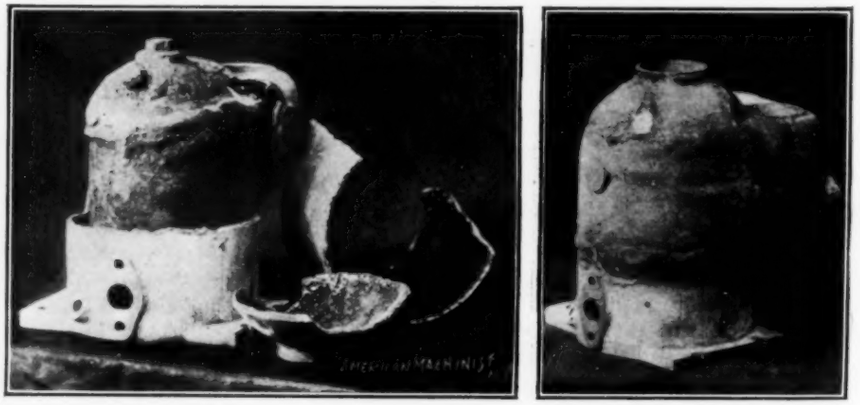


FIG. 10. WATER JACKET REMOVED TO WELD CYLINDER HEAD AND HOW IT APPEARED AFTER REPLACING

FIG. 11. BROKEN PARTS OF GEAR CASE

FIG. 12. GEAR CASE AFTER WELDING BROKEN PARTS TOGETHER

FIG 13. SINGLE C-FRAME FOR PUNCH PRESS AFTER WELDING

FIG. 14. DOUBLE C-FRAME FOR PUNCH PRESS AFTER WELDING

FIG. 15. WELDED BLADE OF 6-FOOT STEEL PROPELLER

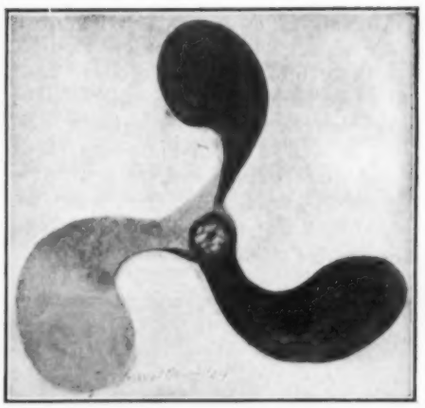


FIG. 16. BORE REDUCED ON BRONZE PROPELLER

FIG. 17. SPLIT PULLEY 48X12, SAVED BY A WELD

FIG. 18. AN ALUMINUM CASE AFTER WEDLING NOW IN USE OVER ONE YEAR

the accompanying pictures. In Fig. 10 is shown an automobile-engine cylinder that was badly broken in the cylinder head. The figure to the left shows how the water jacket was cut off so the cylinder head could be welded up in the places shown by the white streaks and patches. After welding the head, the water jacket was welded back on; the completed job being shown to the right of the halftone.

FIG. 19. SAMPLE OF CUTTING ON BOILER PLATE BY OXY-CARBI COMPANY

In Fig. 11 are shown the broken parts of a cast-iron gear case from a Ford automobile, and Fig. 12 shows the completed case after these pieces were welded together. This might appear like an expensive proposition, but the case was welded up cheaper than a new one could be procured, and it is in use today.

Welded Punch-press Frames

Another interesting job is shown in the punch-press frame in Fig. 13. Immediately back of the opening, as can be plainly seen, this press was welded on August 12, and has been in constant use since that time. Next to the opening the metal was 5 inches thick, which would make the iron back of that anywhere from 2 to 3 inches thick. No machine work was necessary after welding this piece, which was done for Kilbourne & Bishop, New Haven, Conn., who use it on job forgings.

Another job of the same nature is shown in Fig. 14. This is a double punch-press frame that was welded on both sides where the white marks are, as it was broken into two pieces. The metal on this was 3 inches thick on the reinforced part back of the opening, which would make the balance about 1½ inches thick. Each side that was welded was 14 inches across, the casting being from 3½ to 4 feet high.

Miscellaneous Jobs

In Fig. 15 is shown a steel propeller wheel, one blade of which had a large piece broken off and this was welded on.

In Fig. 16 is shown a bronze propeller wheel, the bore of which was reduced by filling with metal.

In Fig. 17 is shown a split cast-iron pulley that was 48 inches in diameter with a 12-inch face. This was saved by a simple weld in the face as shown.

In Fig. 18 is shown an aluminum case after it was welded. Three pieces were broken off of this and the white lines to the right of the partition show where they were welded on again. This has now been in use over a year without showing any signs of breaking again.

A sample of the cutting done by this company is shown in Fig. 19. This is a piece of boiler plate that was cut by starting two holes in the center and cutting from them. As shown, it is about one-half of the size of the original piece.

A Vacuum Motor

By J. C. Lelaine

When the player piano and piano players were first introduced it was quite a problem to determine what would be the best form of motor for rolling the sheet music.

The piano player is operated on a vacuum principle, the notes being struck by the pressure of the atmosphere. The foot pedals on the player piano exhaust air from a chamber which is connected by rubber tubes to all of the little bellows that operate the different parts. As this system insures the fact that a vacuum will be available, a motor was devised which would work in connection with this pneumatic vacuum system.

Operation of the Motor

The front view of one of these motors as installed in a player piano manufactured by the Baldwin Piano Company, of Cincinnati, is shown in Fig. 1, and an end view of the mechanism in Fig. 2. A front view of the entire player piano showing the arrangement of the various parts is given in Fig. 3. The operation of this motor is as follows: When the vacuum has been established by means of the foot-operated bellows, a small key is pressed which releases the motor, and immediately air from the atmosphere enters through the open ports, which in Fig. 1 are shown at the left. This air forces open four long bellows, one of which is shown plainly in the foreground in Fig. 2.

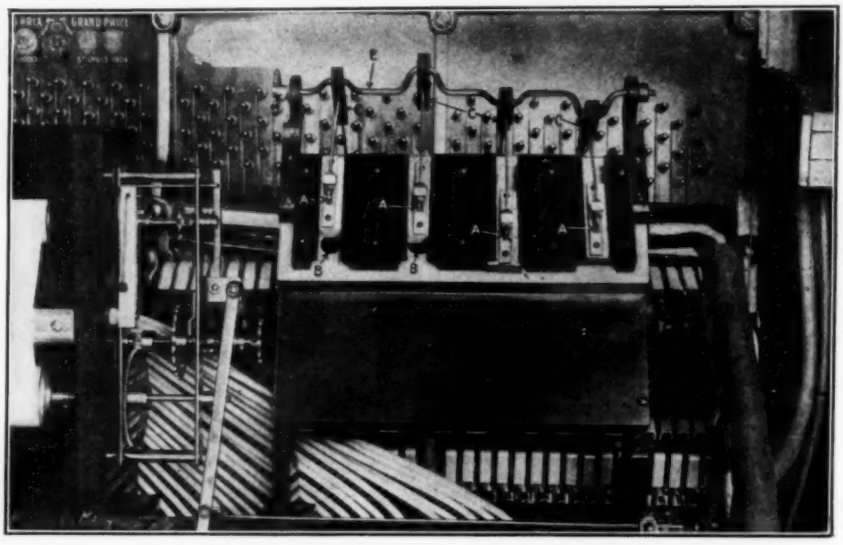


FIG. 1. GENERAL VIEW OF VACUUM MOTOR

A, slide valves. *B*, ports. *C*, connecting rods which turn crank shaft. *D*, vacuum pipe. *E*, crank shaft.

Motion of the bellows is transmitted by the connecting rods to the crank shaft, establishing the rotation of the latter, and as there are four cranks with their corresponding valve mechanism, we have the equivalent of four single-acting cylinders or two double-acting cylinders. Thus the motor can never stop on dead center.

The slide valves are made of hard maple

and ride on hard maple valve seats. Formerly it was considered essential to treat the face of the valves with graphite to reduce friction, but it has been found that if the body of the maple is simply oiled slightly, it will run indefinitely without appreciable wear, and the friction is found to be very small indeed.

One advantage of the vacuum type of apparatus is that the vacuum serves to keep all the valves securely down upon their seats and to draw all the joints together rather than to push them apart as pressure would do. Thus leakage is minimized. The valve mechanism is quite clearly shown in Fig. 2, the valve rods being fastened to the connecting rods, but working at right angles to the latter. This eliminates eccentrics and their friction. The other ends of the valve rods are

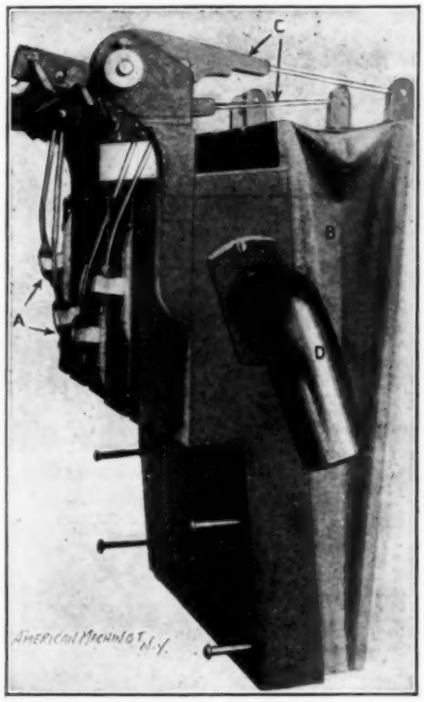


FIG. 2. SIDE VIEW OF MOTOR

A, slide valves. *B*, bellows which act as cylinder. *D*, vacuum pipe.

secured to the valves by means of pivoted posts. The nuts shown in the illustration on each side of the posts are made of leather.

Player Mechanism

The player mechanism is driven from the engine by means of small sprocket wheels and chains. In Fig. 1 the chains were removed, but in Fig. 3 they are in place. Fig. 3 also shows the large number of small bellows which operate the playing hammers.

The player mechanism is not rigidly connected with any part of the regular piano-hammer mechanism, but connects with the latter by means of lugs situated upon the spindles known as the abstract, or sticker, of the regular piano movement. When the motor rolls the music sheet past the openings in the bar at the front of the instrument, the openings in the music sheet admit the atmospheric air through the rubber tubes to the sets of small bellows in the player mechanism, and thus operate the striking hammers to play the notes.

Secrecy in Shops and How It Worked in One Instance.

By E. A. Dixie

There have been editorials on the above subject from time to time. While it has a tragic side from the viewpoint of the mechanic who has traveled a long way to get material for an article only to be told "we do not allow anyone to go through our shops," still there is a funny side and at times this secrecy acts as a boomerang.

The other day I went to a shop in Jersey where they do some very nice work and where they must have some very interesting ways of doing it.

I got as far as the office but no further, being told that no one is allowed into the shop. As I sadly turned to go the boss pulled a piece of threaded wire out of his pocket and said: "Have you ever seen any of that work done?"

It happened that the week before I had seen work, exactly similar, done at enormous speed and at very low cost with the cheapest kind of labor.

So I got out my pencil and made a rough sketch of the device, explaining it as I proceeded. I also told him that I expected the device would be fully described and illustrated in the American Machinist before long. The sketch was made on the back of one of my cards.

Two weeks later a boy called on me with my card, on the back of which was my sketch, and written underneath.

"Please tell bearer in what issue of the Machinist the threading device was illustrated."

I wrote in reply somewhat as follows:

"I called on you and wanted to go through your works—the doors were closed. Now you want me to open the doors of another's factory to you. This is not very consistent."

I have a file of the American Machinist which runs back some years. The other day a man called and producing a patent specification said:

"My name is so-and-so. I have $500,000 invested in making certain articles, I now find that this man (tapping the open specification) has a patent on the method we use. I would like to look through your files to see whether anything has been printed on the subject in the American Machinist previous to the date of this man's application.

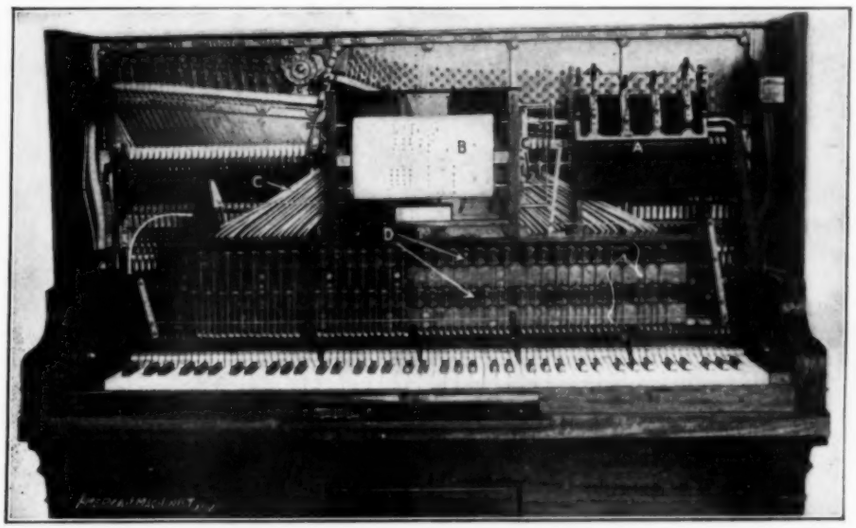


FIG. 3. GENERAL VIEW OF MECHANISM

A, vacuum motor. *B*, perforated music sheet. *C*, rubber tubes from perforations to playing bellows. *D*, playing bellows which operate the striking hammers.

"We were making things in this same way two years previous to the date of this application but we want as much support as possible for our suit."

In conversation with this man I found that there was a lot of interesting work being done in his shop and suggested that some of it might be worth publishing. He threw up his hands and said he would not think of giving out anything for publication.

How foolish! If he had given his method of producing that certain article to the American Machinist at the time he first used it (which was, according to him, two years before the other man put in his application) he would have saved himself much costly litigation. No one but a fool would attempt to support a patent the application for which was filed two years after a description of it had been published.

Aëroplanes of Canadian Aërodrome Company

Two Large Successful Machines Have Been Built: Breadth 50 Feet, Weight 1000 Pounds, Supporting Surface 600 Square Feet, Horsepower 40

BY L. P. ALFORD

Numberless experiments, many trial flights, two successful aëroplanes, a third under construction and well toward completion—such is the record of some eight months' work of the Canadian Aërodrome Company.

It is perhaps a confusion of terms to speak of an aëroplane in connection with an aërodrome company, and demands of courtesy could easily be relied upon as sufficient excuse for my using the word aërodrome here instead of aëroplane; yet in all my previous articles dealing with heavier-than-air machines I have termed them aëroplanes. Thus, to be consistent with previous usage, as well as consistent with general usage, I must use the term aëroplane in describing the machines of this company; although by their originators they are termed "aërodromes."

A few words are necessary to show the relationship of the work of this company to certain work that directly preceded. At page 999, Part 1, present volume, Glenn H. Curtiss told us of the Aërial Experiment Association and the aëroplanes that were built during its existence. This association was dissolved on March 31 of this year. Mr. Curtiss then associated himself with Mr. Herring in the Herring-Curtiss Company, and two of their machines have been illustrated and described in these columns (see pages 49 and 517).

The other members of the dissolved Aërial Experiment Association, Dr. Alexander Graham Bell, J. A. D. McCurdy and F. W. Baldwin, formed the Canadian Aërodrome Company. Thus, the work of the original association has been carried on by two distinct organizations. With the one your readers are familiar; the other will be considered in this article.

The home of the Canadian company is on the beautiful mountain estate of Doctor Bell—Beinn Bhreagh—near Baddeck, Cape Breton. Here is an extensive series of laboratories on or near the shore of Bras d'Or lake, supplied with water power from a reservoir back among the hills. During last winter flights were made over the ice of the lake. During

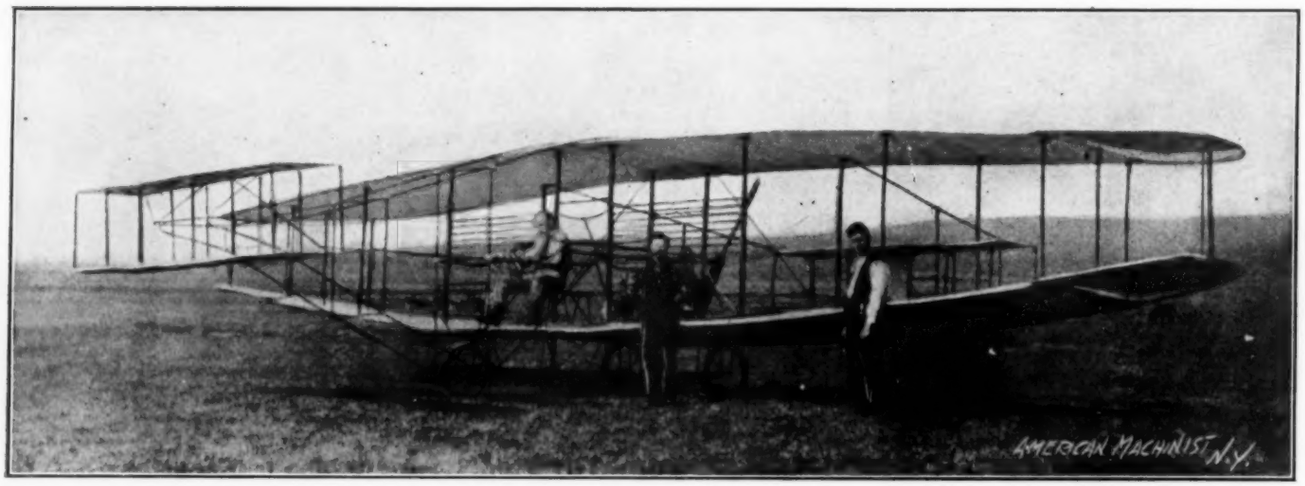


FIG. 1. AÉROPLANE "BADDECK NO. 2" OF THE CANADIAN AËRODROME COMPANY

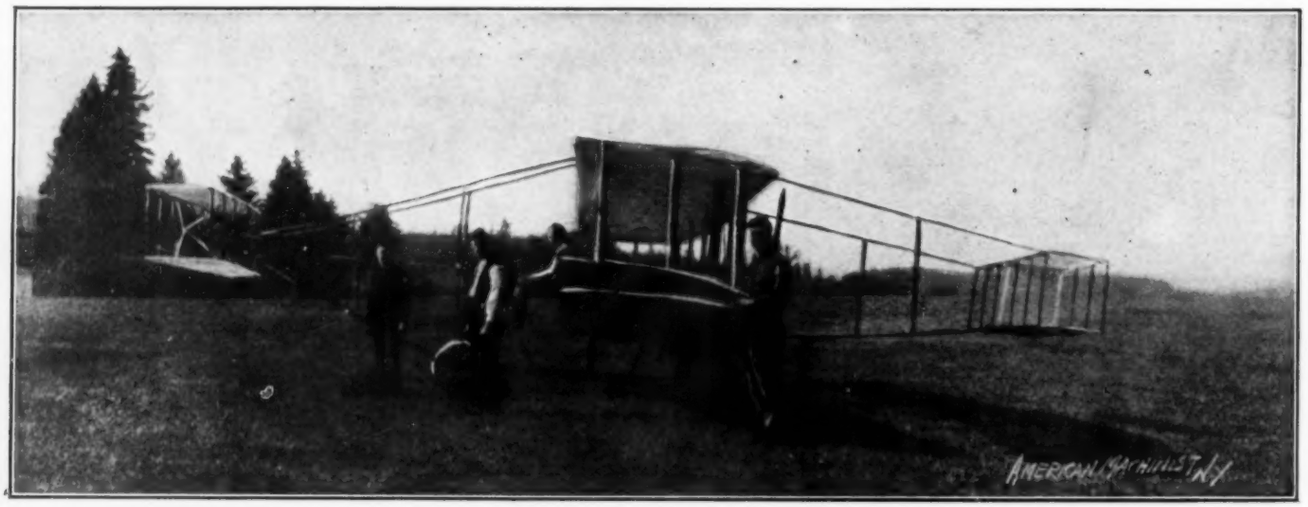


FIG. 2. ANOTHER VIEW OF MACHINE "BADDECK NO. 2"

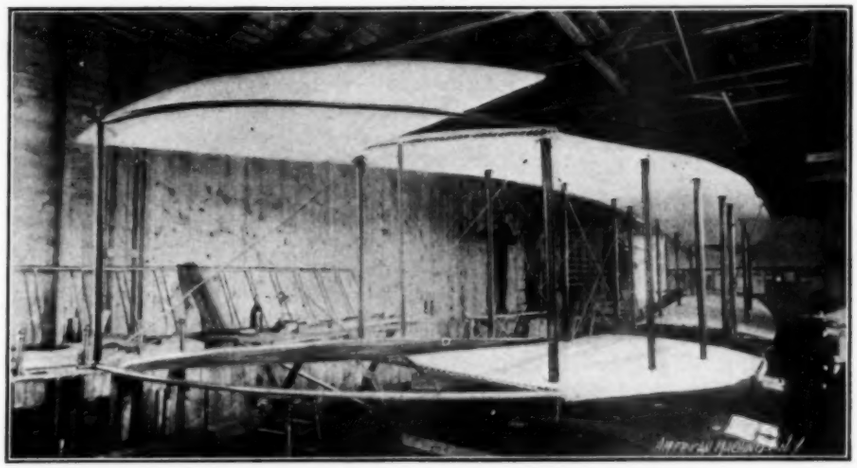


FIG. 3. AËROPLANE "BADDECK NO. 1" ASSEMBLED IN THE SHOP

the past summer and fall flights have been made over a large meadow along the Baddeck river, and about 10 miles from Beinn Bhreagh.

The Machines

Mr. Curtiss in his article took up the work of Doctor Bell with tetrahedral kites of various designs and sizes, aiming toward a heavier-than-air machine built on that principle and flying under its own power. Experiments have been continued along these lines, but it is with the machines that are the lineal descendants of the "Silver Dart" that we are more particularly interested here.

The two machines that have flown are "Baddeck No. 1" and "Baddeck No. 2." The first was used at Petawawa, Ontario, in connection with the "Silver Dart." The flights were in June last. Both machines suffered damage. "Baddeck No. 1" is—at the time of this writing—undergoing repairs and alterations.

"Baddeck No. 2" is identical in size, design and construction with "Baddeck No. 1." It has been used in some 50 flights over the meadow referred to—the longest one of 16 miles on November 1, at an estimated speed of 40 miles per hour.

These few facts are sufficient to show the importance of this work done on Canadian soil.

A third aëroplane of a radically different design is under construction.

General Features of the Machines

"Baddeck No. 2" is shown in Figs. 2 and 3. The machines of the Aërial Experiment Association are at once suggested, but there are many improvements in design and construction over the prototypes. The supporting planes are curved from the horizontal and brought nearer together at the ends than at the center; the balancing mechanism is movable wing tips; in front is a rudder for elevation; in the rear is a stationary tail and a rudder vane for turning. The structure is mounted upon a substantial framework having three pneumatic-tired wheels. The six-cylinder engine is fastened to the framework just above the lower plane and drives a two-bladed wooden propeller through a roller chain. Such are the general features.

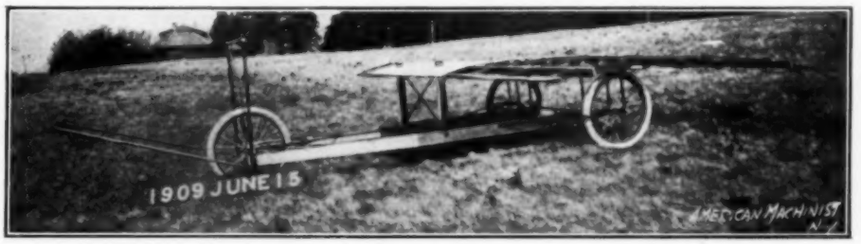


FIG. 5. TRUCK OF AËROPLANE "BADDECK NO. 2" BEFORE ASSEMBLING INTO THE MACHINE

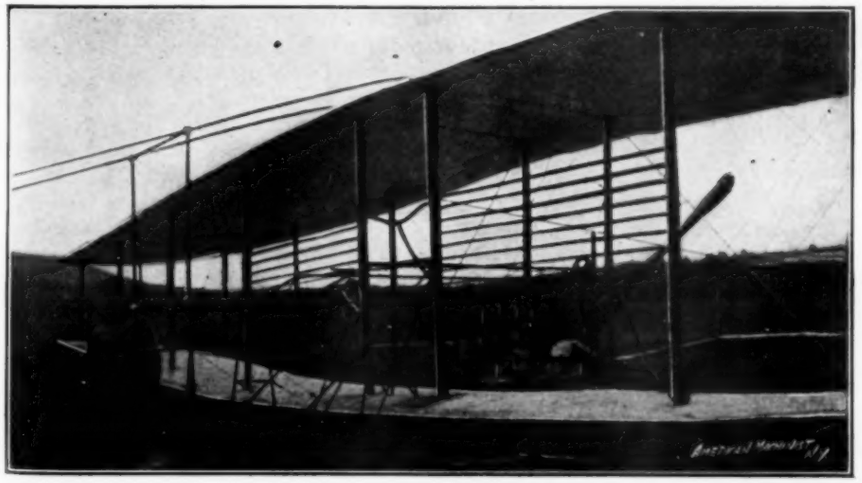


FIG. 4. HAND WHEEL, RADIATOR AND POWER PLANT OF THE "BADDECK NO. 2"

General Dimensions

The machines are large, the largest successful machines yet built on this side of the Atlantic. Breadth over all, 49 feet 4 inches; breadth exclusive of wing tips, 39 feet 4 inches; length over all, rudder to rudder, 33 feet; weight with aviator, 1200 pounds, supporting surface 600 square feet, giving a weight factor of 2 pounds per square foot; horsepower at 1400-1500 revolutions per minute of the engine, 40.

The Main Planes

Each main plane is 39 feet 4 inches long and 7 feet wide. The framing is of clear, well seasoned spruce covered with a fine quality of duck, known as "racing cloth," made for the smaller sails of yachts. Experience has shown that the rubberized silk or linen such as was used on the "Silver Dart" rots out in a short time and becomes worthless.

The ribs are each a very light spruce truss, see Figs. 6 and 7, fastened to four longitudinal strips. As shown there are but three of these strips, for sheet aluminum was used at first to hold the fabric at the rear. A later construction adopts a light longitudinal bar in place of the sheet aluminum. Over this bar the fabric is stretched, covering both surfaces of the ribs and is securely laced in front over the front bar. This lacing is then covered with sheet aluminum and the plane presents perfectly clean surfaces to the air.

I have said that the ribs are light wooden trusses. Each edge of the truss is laminated, made from two thin pieces glued together and shaped in forms under pressure. The spacing pieces are blocks of spruce glued in position and bored out with a central hole to lighten them.

The method of making these ribs is of interest. Thin boards, eight inches wide, are bent and glued together to form the sides of the ribs. Two strips thus shaped are then glued together with the proper spacing blocks between. Each block is then bored with the central hole and the

FIG. 6. GASOLENE TANK AND RIBS

FIG. 8. PROPELLER SHAFT AND FLANGES

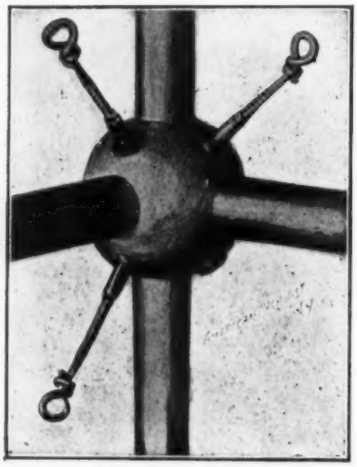


FIG. 9. ALUMINUM FRAME JOINT

wide strip is sawed up into individual ribs with a circular saw.

The main planes are spaced apart with fish-shaped struts of spruce trussed with steel wire. The connections between the struts and the longitudinal bars of the frame are substantial sheet-metal sockets. The struts are securely tied together horizontally; the entire scheme of construction gives a main-plane structure of great strength and rigidity. By means of the struts the space between the main planes is divided into 9 panels including the wing-tip sections at the ends. The horizontal breadths beginning with the center section and reading to the end are 3 feet, 6 feet 7 inches, 6 feet, 5 feet, 7 inches and 5 feet. The distance between planes at the center is 6 feet 3 inches; at the ends 3 feet.

The Truck or Chassis

In Fig. 5 we see the truck before assembling with the main planes. It is a substantial triangular framework of wood carrying three 26-inch motor cycle wheels with 2½-inch tires. The front wheel can be steered.

The Front Rudder

The front rudder or control for elevation consists of two parallel planes 2 feet wide, 12 feet long and spaced 30 inches apart. They are placed 15 feet from their front edges to the front of the main planes. The framing, struts and trussing are similar to those of the main frames but, of course, much lighter.

This rudder is pivoted about a horizontal axis midway between planes and a little back of the front edges. See Figs. 1 and 2.

The triangular frame carried out from the main planes is made of sections of light steel tubing ⅝ and ¾ inch in diameter fitted together with aluminum joints and stayed with wire. One of those joints is shown in detail in Fig. 9. The ball is drilled to receive the end of the tubing, tapped for a special set screw and the tube is slotted to receive the end of the screw. The screws are also tapped for bicycle nipples to fasten to the trussing wires. Thus the special set screws serve the double purpose of fastening in the tubing and providing fastening for the wires. When two tubes passing in the same direction enter a joint, they are telescoped and pinned.

The Tail and Rear Rudder

The stationary tail also consists of two parallel planes; each 28 inches wide, 12 feet long and spaced 30 inches apart. They are carried on a triangular steel-tubing frame from the main planes and at a distance of 11 feet from their rear edges to the rear of the main planes. See Fig. 2.

At the center of the length of the horizontal planes and between them is a 28x30-inch, vertical, movable rudder vane. This is hinged around its front vertical edge, and serves the purpose of turning the machine sidewise in the air.

System of Control

The system of control is identical in principle of operation with that of Mr. Curtiss' "Gold Bug" described on page 49 but slightly different mechanism is used.

FIG. 7. RIBS AND LONGITUDINAL MEMBERS OF FRAME OF MAIN PLANE— AËROPLANE "BADDECK NO. 2"

In front of the aviator's seat and at a convenient hight is a handwheel on the end of a horizontal bar that can both slide and rotate. Attached to the front end of this bar is a rod extending to and attached to the upper plane of the front control, the control for elevation. A backward pull of the handwheel from mid position tilts the planes of the control with the front edges pointing upward; similarly, a forward push and the planes point downward.

The handwheel shaft is square in section and carries a small grooved pulley held between guides. The shaft slips through this pulley without giving it any motion, but when the shaft rotates the pulley rotates with it. A fine wire rope passes over this pulley through suitably located guide sheaves to a movable yoke fastened to the front wheel of the truck. To an extension of this yoke are attached wire cords running to the rear rudder vane. Thus by rotating the handwheel the front truck wheel and rear rudder vane are moved in unison, thus steering the machine sidewise when on the ground or in the air.

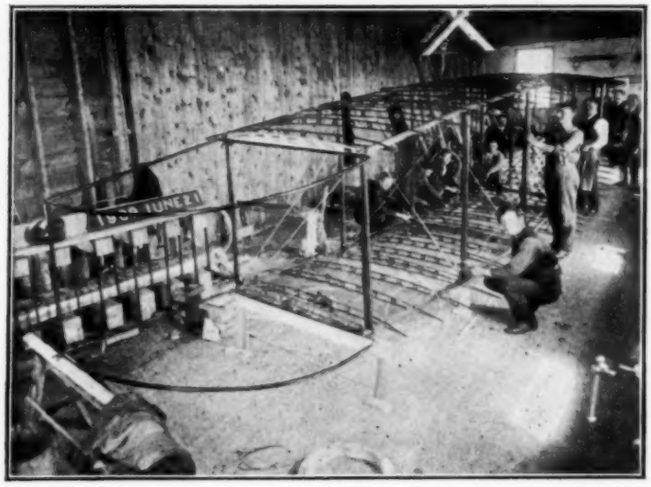


FIG. 10

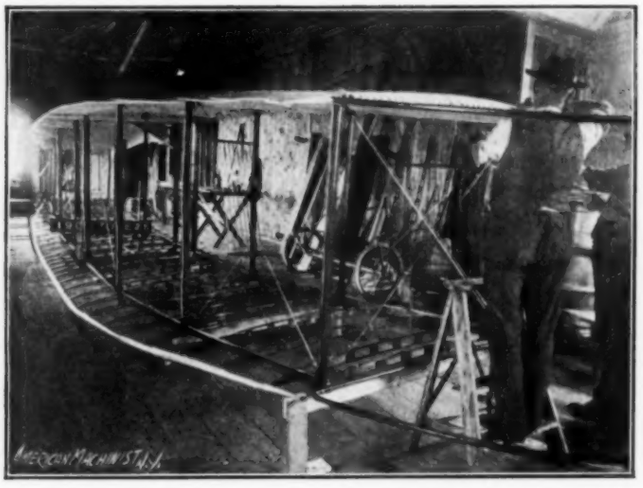


FIG. 11

AËROPLANE "BADDECK NO. 1" BEING ASSEMBLED

In a position to fit around the shoulders of the aviator is a tubing yoke connected to the movable wing tips. The shape, position of the axis and motion of these tips are well seen in Fig. 3, which is of machine "Baddeck No. 1." As the machine tips the aviator instinctively leans his body toward the higher side and this movement communicated from the shoulder yoke to the wing tips sets them to overcome the tipping action and restore equilibrium.

The Power Plant

The motor is a commercial automobile engine, the Kirkham, made in Bath, N. Y. It has six cylinders 4 15/16 inches diameter by 4 13/16 inches stroke and weighs 320 pounds. It is water cooled, splashed lubricated and has a high-tension magneto. Under brake test it develops 40 horsepower at 1400 revolutions per minute and 48 horsepower at 2000 revolutions per minute. When used in flights it is operated at the lower speed.

As it is intended to fly over the ice this coming winter two details of construction have been introduced to better handle the gasolene and lubricating-oil supplies. A water jacket has been put around the mixing chamber of the carbureter, taking water from the engine. In this way the mixing chamber will be kept at a uniform temperature and thus tend to deliver a uniform mixture of gas. To prevent chilling of the lubricating oil a diaphragm has been put into the crank case, holding a quantity of oil always in contact with moving main parts of the engine, while below is the reservoir to which the oil drains and from which the pump takes its supply. Fastened to the aviator's handwheel are a switch in the magneto circuit and a segment for advancing or retarding the spark. Thus the engine is under control.

The drive to the propeller shaft is through a Diamond roller chain over sprockets with a 3:5 reduction. Thus the propeller speed is about 900 revolutions per minute.

The propeller is of laminated spruce, 7 feet 6 inches in diameter and 9 feet pitch. At the hub it is reinforced with flanges having a square tapered hole to receive the shaft. For this detail see Fig. 8.

There are two other details of this power plant that deserve more than passing notice, for they are happy solutions of two problems that have vexed in the past.

The aëroplane radiation has always been a nuisance; clumsy in itself, it has been in the way and extended a considerable surface to the air, offering nearly as much resistance as would a board of similar dimensions. In Fig. 4 will be noticed a number of horizontal strips giving a curve effect. These are flattened and curved radiator tubes entering headers shaped to the struts against which they abut. The tubes are made of this sheet copper having a water space about 1/16 inch wide and the curves of the exterior are aëro curves.

There are 15 tubes on each side as now used, having a total radiating surface of 100 square feet. Half of this is lifting surface having a value of at least 2 pounds per square foot. The radiator weighs 120 pounds, so instead of being dead weight and offering head resistance, by its ingenious design it is made in effect to support itself when in the air.

The other interesting feature is in the shape and location of the gasolene tanks. As ordinarily made and placed they are unsightly and offer head resistance. In the Baddeck machines the tanks fit between the ribs in the middle section of the upper plane, a location out of sight, out of the way, and offering no air resistance whatever. Fig. 6 shows one of these tanks. Three are used having a combined capacity of 14 Imperial gallons (17.5 U. S. gallons).

The total weight of the power plant is about 500 pounds, or one-half the weight of the machine.

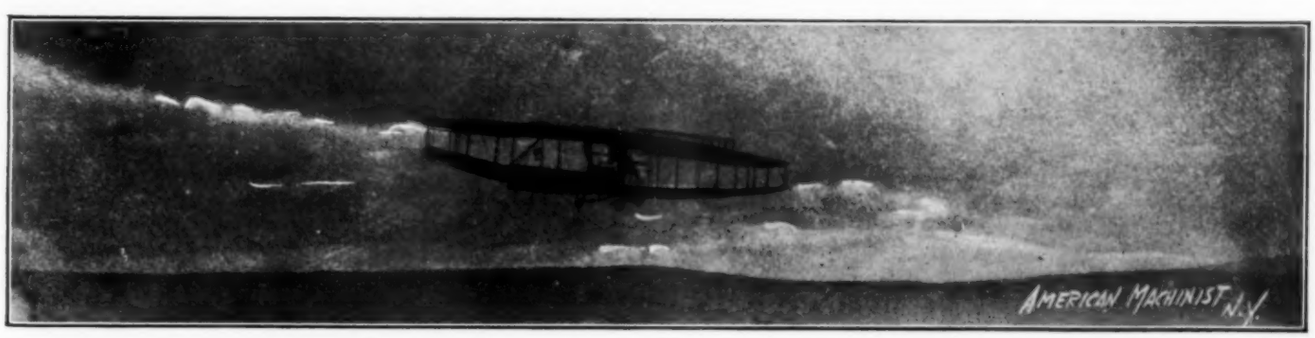


FIG. 12. AËROPLANE "BADDECK NO. 2" IN FLIGHT OCTOBER 21, 1909

Flights

As we have stated, over 50 flights have been made with these machines, the longest at the time of this writing having been 16 miles. When the lake freezes it is intended to continue the flights over the ice, and we have good reason to expect important forward steps in aviation from those trials.

Because of the lateness of the season and unfavorable weather it has been impossible to obtain satisfactory photographs of flights. Fig. 12, however, shows aëroplane "Baddeck No. 2" in flight on October 21 last.

A Milling Machine Turret

The halftones and line engraving illustrate an interesting appliance designed and put into use at the shops of the Funk Machine Company, 23 City Hall Place, New York City. This company builds envelop and other machinery and the mill-

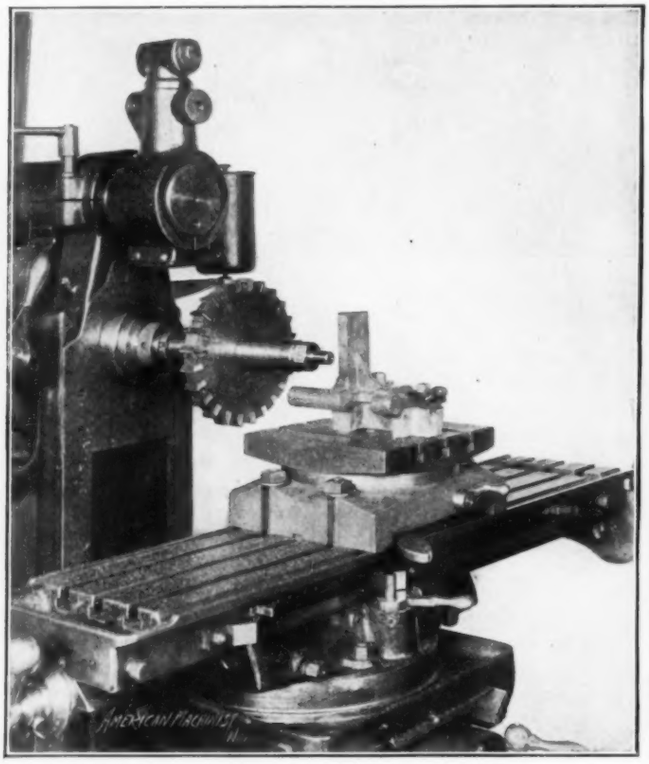


FIG. 1

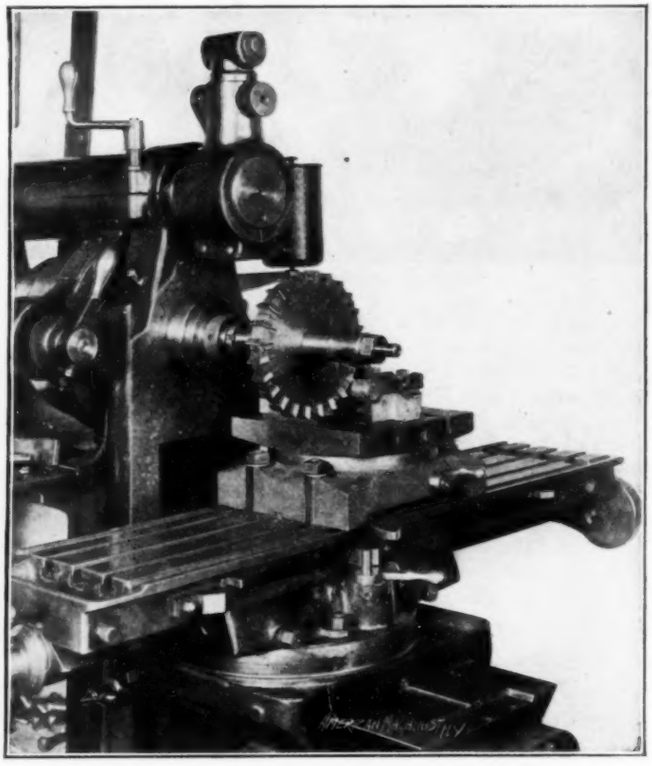


FIG. 2

MACHINING A BEVEL-GEAR BRACKET ON MILLING-MACHINE TURRET

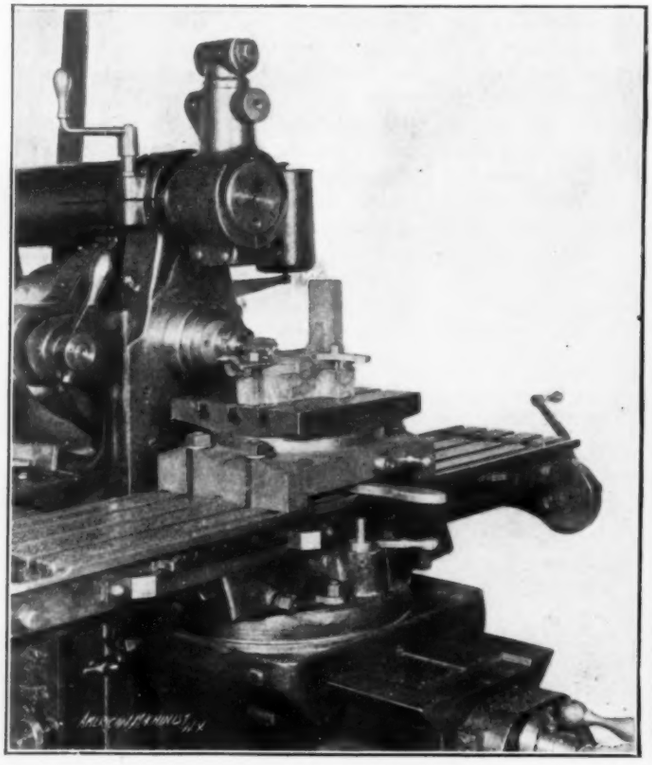


FIG. 3

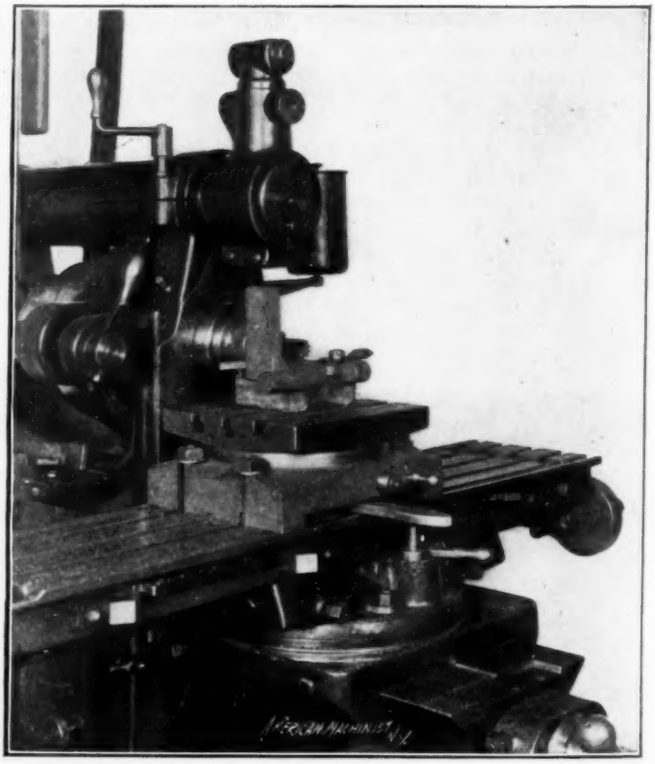


FIG. 4

MACHINING BEVEL-GEAR BRACKET ON MILLING-MACHINE TURRET

ing-machine turret shown was designed to facilitate the handling of a variety of work where numerous settings would be required if the work were to be strapped directly on the table of the machine.

In Fig. 1 a bevel-gear bracket is illustrated in place on the face of the turret, and in this position it is held while the end of the long hub or boss is finished by the large inserted-tooth milling cutter seen on the arbor. Fig. 2 shows the work held in the same way but with the table adjusted toward the column so that the milling cutter can be run in to finish the inner ends of the two lugs or bosses, which are afterward to be bored out to receive the bevel-gear shaft. In Fig. 3 the fixture will be seen indexed one-fourth way around so that another surface may be finished by means of the end mill which is here used in place of the large inserted-tooth cutter. Still another position for the work is illustrated in Fig. 4, the end mill being used here also.

The large cutter illustrated is about 10 inches in diameter and it is possible while using this mill to support the outer end of the arbor by the regular overhanging arm, although this is not essential in taking light cuts on work of the character shown. Hence the arm, as will be noticed, is swung up and pushed back clear of the work and cutter. This same apparatus is also used for drilling and boring operations performed in the miller. It is obvious that the turret may be removed bodily from the machine and placed on some other machine for performing further operations where such procedure may be required.

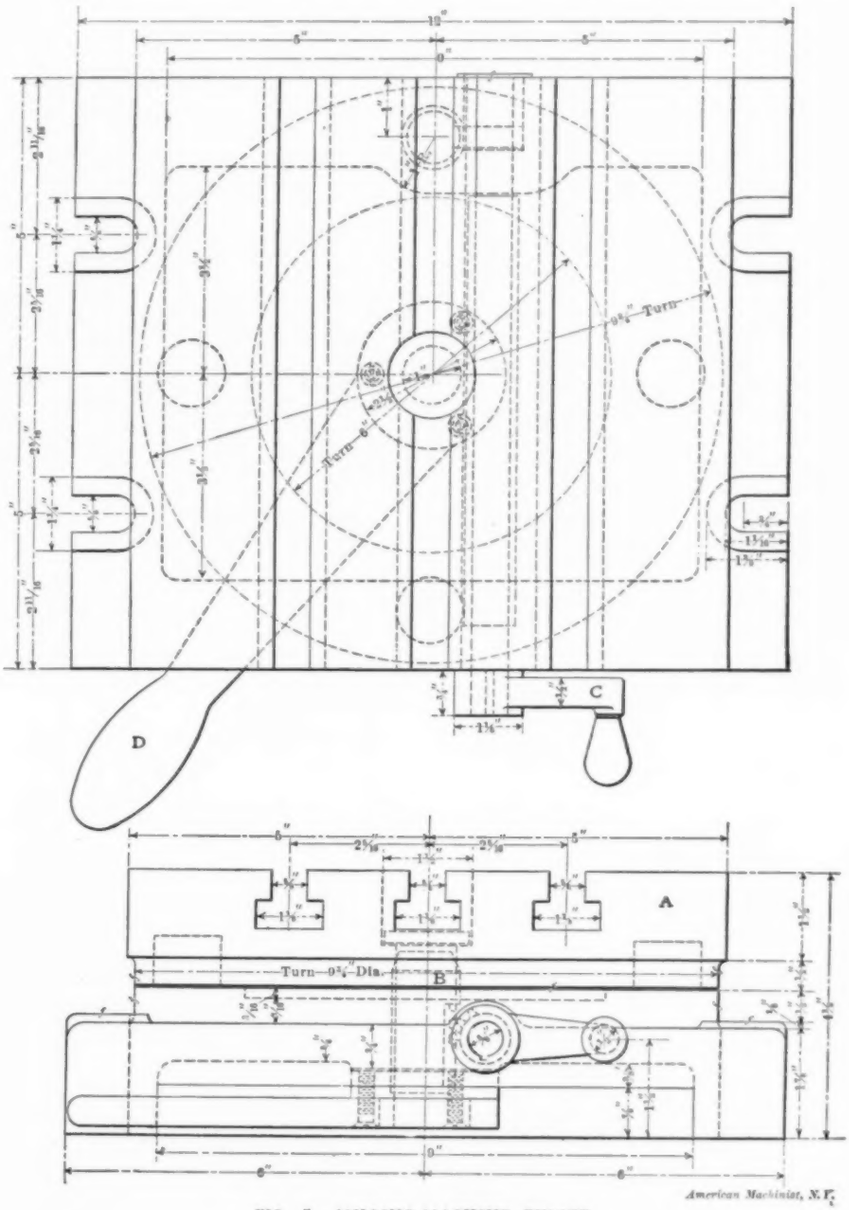


FIG. 5. MILLING-MACHINE TURRET

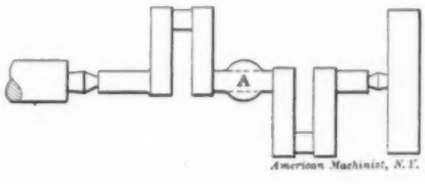
It will be seen that the bevel-gear bracket in the halftones has bosses arranged to be bored at right angles to each other to receive the shafts upon which the bevel gears are placed. In the case illustrated the holes for these shafts is 1⅛ inch diameter. First a drill 1/16 inch small is put through, then a single-end cutter carried in a boring bar supported at the outer end by the overhanging arm is run through and finishes the hole to 1⅛ inch diameter. After roughing out the holes at right angles to each other, then boring one hole to size, the turret fixture may be indexed one-fourth way around and the second hole also machined to size with the boring bar. The machine upon which the turret and the work are shown in the illustrations is a Cincinnati No. 2 universal miller.

The construction of the turret will be understood upon reference to Fig. 5, which gives practically all of the dimensions. The locking bolt for the turret *A* is shown at *B* and is operated by crank handle *C*, which actuates a pinion meshing with rack teeth cut on the side of the locking pin. The seats in which the latter enters to secure the turret in any one of the four positions are formed in the bottom of the turret as indicated by the dotted lines. After indexing, the turret is clamped securely by handle *D*. Of course, where it is desired to index the turret through any angle other than 90 degrees the lock-bolt handle may be depressed, and the turret swung to the angle required and clamped. The construction of the device is such that chips and dirt are readily swept off without interfering with any of the operating parts.

Correcting an Error in a Crank Shaft

By H. Thomas Clark

A large crank shaft ordered from an outside concern, was found on delivery to be 1 inch longer at the center bearing than it had been ordered. The manufacturers were willing to correct their error, but our forge-shop foreman didn't care to wait. Heating the shaft sufficiently at *A* he rushed it over to the big lathe (where provision had been made to preserve correct alinement), and putting it on centers, screwed up the tailstock, whereupon the shaft took the form indicated by the full lines at *A*. It was then worked to correct size.



CORRECTING AN ERROR IN A CRANK SHAFT

Practical Letters from Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

Bending Large Steel Tubes

We had to bend several hundred mild-steel tubes varying from 2¾ to 4½ inches and 0.0128 inch thick. They were to be bent to an arc of 300 degrees, and to be produced with as little distortion from the circular section as possible.

The internal diameters of the circular bend varied from 25 to 29.5 inches. A heavy 36-inch lathe was used for the bending. The tubes were all cut off several inches longer than the required finished length to provide means of holding; this was cut off later. A heavy cast-iron grooved former and a grooved roller were provided for each size of tube and diameter. The former was cast in halves so that the tube could be taken off after bending. The former was bolted to the heavy faceplate of the lathe. The grooved roller was mounted on a journal on a heavy square shaft bolted to the lathe shears.

Each tube was provided at one end with an iron plug about 3 inches long, having a hole drilled through the pipe and plug 1 1/16 inches diameter, through which a 1-inch bolt was put to fasten it to the former.

The tubes were filled with lead, as sand, rosin and pitch would not prevent prohibitive sectional distortion. Having fastened a tube to the former, the roller was brought up and the lathe was started on the slowest back-gear speed. A helper stood by with a piece of 3x2-inch scantling for a brake for the lathe at the instant the tube end had reached the center of the grooved roller.

Each tube was permitted to remain in this position on the former for a few minutes to allow the strains to set. Little rebound of the tubes was perceptible, each being found to be within ⅛ inch of the external diameter of the former, while distortion from the circular section took place to the extent of 3/64 inch only. A half hour each was found to be ample time to bend one tube of either size.

London, England. TUBE BENDER.

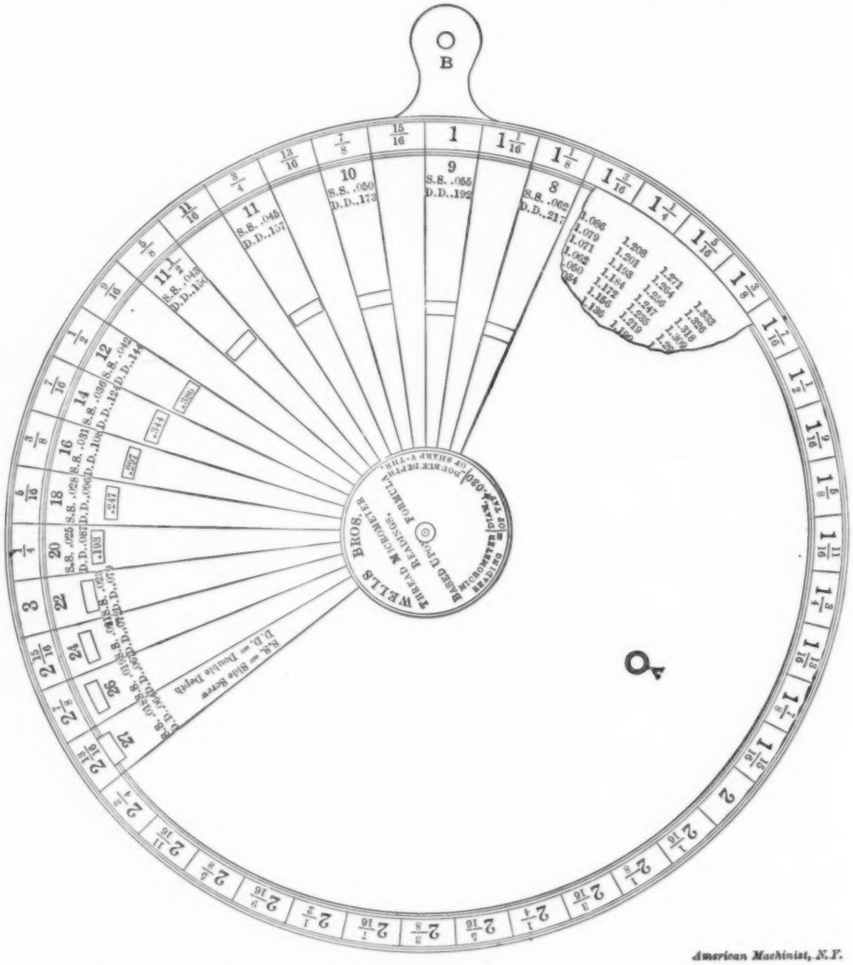
Drawing Temper in Emery

I herewith submit a recipe which I have found unfailing whenever used. To draw the temper on small steel parts put them in hot emery. It distributes the heat evenly, is much cleaner than lead and safe to handle. It conforms to all irregular-shaped work, and assures an even temper.

Waltham, Mass. S. W. GREEN.

A Wheel Chart for Thread Micrometer Readings

In the tool room where I am employed all the taps are measured in the angle of the thread by Wells Brothers' thread micrometers. The correct readings are found by formula, and in order to save time I devised the "wheel chart," which we have found very convenient, for by its use we can quickly find the correct reading for any size tap in any pitch of thread that we are likely to be called upon to make or measure.



WHEEL CHART FOR THREAD MICROMETER READINGS. ACTUAL DIAMETER 10 INCHES

The chart consists of two dials, the larger of which (10 inches diameter) has marked on its outer circle the tap sizes from ¼ to 3 inches, inclusive, by sixteenths. Under each tap size is a column of decimals; these are the micrometer readings for all the different pitches likely to be needed. These decimals are also in concentric circles, all the readings for the 27 pitch occurring in the second circle, for 26 in the third circle, and so on.

The smaller dial covers these decimals and has marked on its outer circle the pitches 27, 26, 24, etc., and in the same radial space there is a peep hole. These holes approach the center of the dial, being cut on circles corresponding to those on the larger dial and expose the correct reading for the size tap and pitch that register on the outer circles.

Any pitch is readily made to register with any size by revolving the dials. The side-screw movement for the anvil of these micrometers and the double depth of thread are marked in their proper space. The small circle in the center contains the formula upon which the readings are based. The button marked *A* is for revolving the dials and the ear *B* for hang-

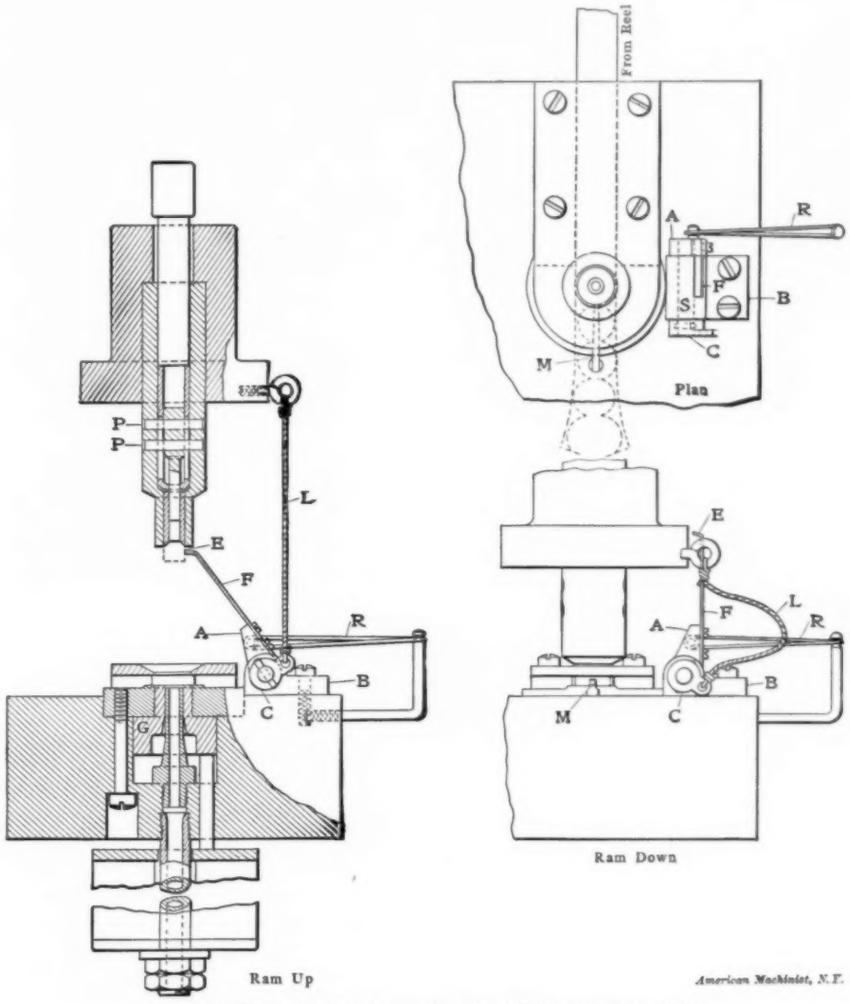
ing up the chart. The materials used are blueprints and tin disks upon which the prints are mounted.

LEONARD A. PURSELL.

Wadsworth, Ohio.

A "Knockoff" for Removing Shells from the Punch Press

In operating the combination die shown in accompanying sketches, difficulty was experienced in freeing the completed shells from the ejector. The press was sharply inclined, but most of the shells refused to drop, held probably by the formation of a partial vacuum, when the ejector sleeve was forced downward by the knockout.



KNOCKOFF FOR REMOVING SHELLS FROM PUNCH PRESS

The shells were, of course, wanted immediately, and as no air pressure was available, the "knock-off" shown was quickly constructed and fitted.

The bearing block *B*, screwed to the die bed, carries the shaft *S*, upon which are mounted the collars *A* and *C*. To collar *A* is fastened the strip of sheet steel *F*, bent as shown. Collar *C* is provided with a projection, drilled to allow cord *L* (fishline previously well stretched) to be attached. The other end of the cord is fastened to a screw-eye in the punch holder. This cord is so adjusted that when the ram is at its highest position, the end *E* of the metal strip is about on the centerline of the punch. In the partly sectioned view, the ram is within about 1/32 inch of its highest position, the edge of the strip just touching the completed shell, as shown. When the ram descends, the cord slackens, and the rubber band *R*, attached to collar *A* and bent stud *D* pulls the strip clear of the descending punch.

The device works perfectly; 25,000 shells were run off in the first setting at the rate of about 5000 per hour. The "knock-off" snapped the shells entirely clear. The shells are ¼ inch outside diameter, 7/32 inch deep, stock No. 26 Brown & Sharpe gage soft brass, ½ inch wide.

The die and punch are of the conventional combination cut, draw, and piercing type. The method of securing the piercing punch may be of interest, as it provides a simple and rigid fastening, with the minimum of labor.

The piercing punch was fitted tightly in the ejector sleeve, and the ejector sleeve was also made a tight fit in the blanking punch. After assembling all parts in correct position, the holes for the pins, *P P* were drilled and reamed through blanking punch, ejector sleeve and piercing punch. The ejector sleeve was then slotted, and all parts lapped to a rather snug sliding fit. After re-assembling the pins were driven in and slightly inverted as shown.

The stock stop *M* was fitted to come flush with the cutting edge of the blanking die. The appearance of the scrap after passing through the die is shown in the dotted lines on the plan view.

When punching, the operator fed the stock through until he was able to grasp one end of the scrap.

By pulling steadily on this end, the press could be run continuously until an entire reel of stock was exhausted.

The pressure ring *G* is a sliding fit in the die bed, and the piercing die, which also acts as the drawing punch, is a close sliding fit in the ring, thus closely supporting this rather slender and hard worked part.

Jersey City, N. J. E. M. E.

Specifications for Buying High Speed Steel

This is a subject that stirs me to the extent of showing how the analysis looks to the hardener for a basis in buying tool steel. The success of steel in tools is a combination of good material, proper heats, proper handling, together with muscle, brains and fidelity to duty. It will never be possible to strike a dead level of uniformity in tools by any table of rules or by any written or verbal instructions. I have been benefited myself by what I have read and hope that I have benefited someone by what I have written. But after all is said and done, it still remains true that the successful handling of tool steel is in the man himself. Eliminate the individual, the character, skill and thought of the man at the fire, and substitute therefor an inanimate machine and a set of dogmatic and irresponsible rules, and what becomes of the dignity of work or the superiority of conscientiousness? Is it the typewriter that creates the thoughts, or records them?

I know something of the history of steel and the wonderful effects of the heat treatment, of forging, of tempering and of grinding. I have tried to know the hundreds of pages that have been written in the AMERICAN MACHINIST and similar papers testifying to the wide range of results and surprises in the manipulation of tool steel. Whence comes this great variation in results reported by these numerous writers from time to time? Whence come all these contradictory reports of success and failures with identically the same tool steel?

When I took charge of the tempering

department at my present place, the loss was 45 per cent. It has been reduced to the phenomenal point of ½ of 1 per cent. without making any change in the steel supplied. Can success of this kind be analyzed in a laboratory? Can any chemist put his finger on the secret spring, opening the treasure box of my experience and success? If we, who harden tools and treat steel, know this about steel as it passes through our department, what can be said of the attempt to eliminate the human element in the making of the steel itself?

If a man determines the capacity of a tool by the way he handles the steel, how can it be claimed that a man counts for nothing in the making of steel? If the personality of the tool hardener makes an impression on the life and quality of a tool, does not the personality and skill of the steel melter, steel hammermen, and the steel roller make an impression on the life and quality and strength and uniformity of the steel?

There is more in a tool than any chemist will ever find. There is more in a bar of steel than any chemist will ever find. It is truly beyond the reach of any laboratory to weigh or measure all the properties of a bar of steel. Chemistry is a necessary guide in steel making but it will never be master. Pyrometers are necessary as a guide in tool hardening. The microscope is a necessary guide in making examinations in tool hardening and heat treatment of steel but neither will become masters. Chemistry can indicate what will renew and add strength to the soil—but chemistry will never grow crops, without the help of man. Chemistry is only one thing in combination with rain and sunshine and the sweat of the brow to make a garden grow and the grain to ripen.

The reason that one steel works makes better steel than another, will be found in the difference in the organization. It will never be true that one man's work is on a dead level with another man's. It will never be true that one organization of steel workers cannot make better steel than other organizations of steel workers. It is in the aim, the determination, the honesty, the loyalty, backed by financial strength, backed by a pride of reputation and a desire to excel. It is because there are so many things outside the bounds of science that explains why one steel works, with the same raw material, will not make as good steel as another steel works.

How can tool steel be bought on chemical analysis when chemical analysis is the least important thing about the steel? It is important of course. The laboratory and the chemist are useful but all these things that can be seen are insignificant as compared with the unseen—the unseen force that spurs workers to do their best.

Why do we find a variation in the efficiency of high-speed steels? Is it due to the chemical analysis? Surely not, if the best of this steel can be had by chemical analysis in the purchasing, then it is true. Eliminate the man element from steel making or tool making, put your faith in lifeless metal and what becomes of the dignity of work and the usefulness of fidelity? It is not a question of what carbon, and tungsten, and iron, etc., can do with man, but it is what a man can do with carbon, tungsten, iron, etc.

Let us take the best bar of steel that was ever made in all the world and cut this bar in halves and send out one half to a manufacturer who has pyrometers, furnaces, and all that is necessary for the proper treatment of steel, including the hardener. We will then send the other half of this best bar of steel to another manufacturer who has the pyrometer, the furnaces, the cooling baths, in fact, he is provided with all that science has produced for the hardening and heat treatment of steel, but he has not the man; the hardener with sufficient judgment to determine the rate of heating, the rate of cooling, the temper to draw at, etc. What will become of the tools which might have been the best tools ever made in all the world? What will be the difference in the two halves of the bar of steel?

Have not all steel manufacturers access to all the ores and minerals entering into the manufacture of steel? Have they not got the best of laboratories for making analysis of their steel, as well as analyzing their competitor's product? This being an acknowledged fact and admitting that high-speed steel can be bought from a chemical analysis, then why are not all high-speed steels of the same efficiency? We must admit that there are a few brands of high-speed steel leading all others.

If the analysis is a safe purchasing basis, why do not these steel mills imitate the analysis of their competitor? The chemist has had access to the chemical analysis of all the steels that have been made during the latter year of progress. And truly there has been a great improvement in the steel manufactured, yet we find a great variation both in efficiency and price of their products.

The metallurgist and chemist have gone to the fiery furnace with the analysis of the best steel that was ever made and expected to reproduce this steel. Some have succeeded, others have failed. Their failure may be the dawn of the brightest sunrise the steel business has ever known.

Leave the analysis to the steel maker; learn to use the best he is able to produce; be sure that you are getting the full value of the steel you are using; add to your store of knowledge of the cutting powers of the steel by learning to heat, without injuring the steel, and that heat alone will determine the efficiency of high-speed steel.

Davenport, Iowa. C. U. Scott.

Wiring Work for the Hardening Room

Numerous articles have appeared from time to time in the American Machinist, on methods used in hardening, but not enough has been said, to my knowledge, in regard to preparing, that is, wiring small work in quantities for the hardening room. In typewriter-, adding-machine- or similar work, where the parts are small and number into the thousands, great care is exercised in machining these parts accurately to gage; therefore, great care should also be used in hardening, so that the work will gage properly. A large percentage of good work is often lost or spoiled through carelessness in preparing or wiring work in a haphazard way and dumping the contents of a box into the bath.

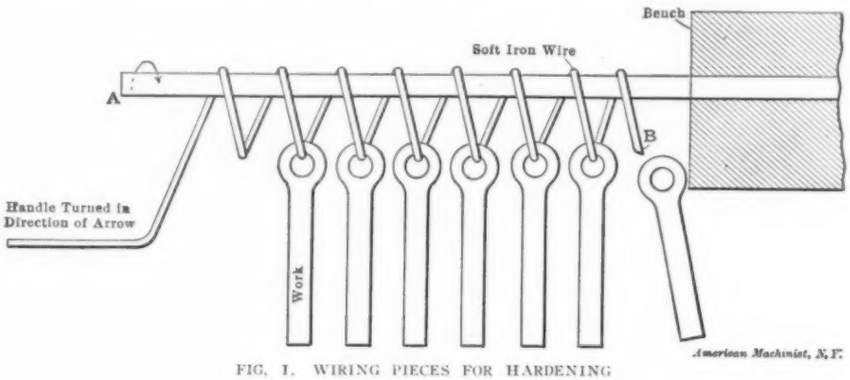


FIG. 1. WIRING PIECES FOR HARDENING

If we were to harden one piece, say like the slender piece in Fig. 1, we would surely attach a piece of wire to one end and immerse it in the bath as straight as possible to avoid distortion. If we were to harden 1000 pieces this method would be rather slow and expensive, although it would not be expensive if we were to consider the time it would take to straighten the pieces afterward, if they were wired any old way and dumped into

the bath carelessly. My method of wiring, shown in Fig. 1, and in the halftones, Figs. 2 and 3, has proved to be a success, not only as a time saver in wiring the work, but as a cost reducer in dispensing with straightening the work, because the principle of dipping the work is the same as referred to in wiring and immersing one piece at a time.

In this method a coil of wire is wound on an arbor in the shape of a spiral spring. The wire should be wound close so it can be stretched or opened to suit the part to be wired, as in Fig. 1, then cut in lengths to suit the box. The next procedure is to place the end of a stiff rod *A* in the hole in the bench and place the coil through, as shown. By bending the other end like a handle the coil is turned or rotated on the rod *A*, and at each turn a piece of work is caught in the loop *B*, moving it forward as in the sketch. Fig. 1 shows all the pieces wired except one; upon turning the coil one more turn the other piece is brought forward so as to catch the wire and complete the string. The coil and rod *A* are now ready to be placed in the box ready for the heat. In removing the work from the bath the rod *A* is held by both ends and the work is immersed properly, that is, straight down. The pieces are left on the wire during the pickling and cleaning process, and if removed carefully, can be used over again.

Figs. 2 and 3 show different ways of using the coil-spring method, also samples of pieces wired. This method of wiring pieces could be used to advantage in nickel plating and similar processes.

A. C. LINDHOLM.

New Haven, Conn.

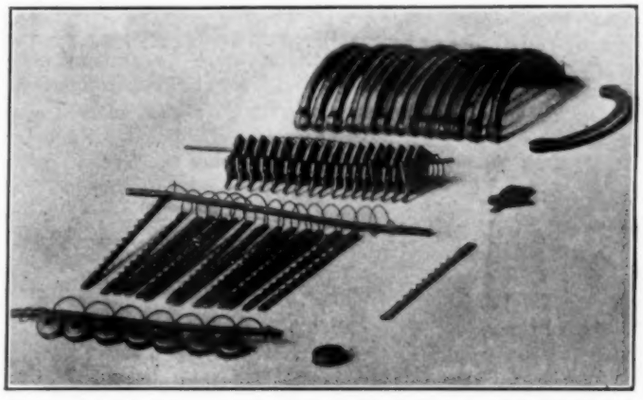


FIG. 2

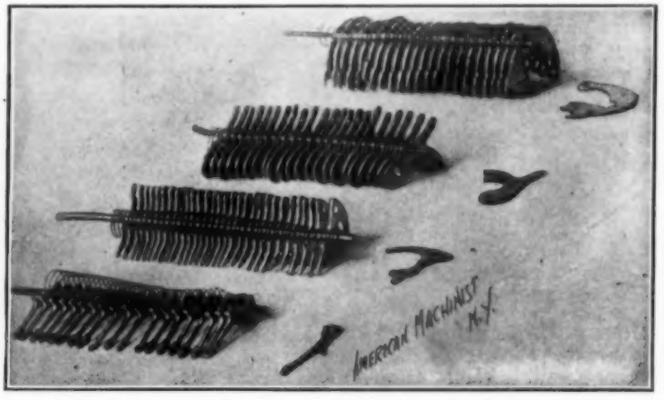


FIG. 3

WORK WIRED READY FOR HARDENING

A Stock Stop for Press Tools

The accompanying sketches show a most efficient stop for punch and die work. It is positive in its action as the stock cannot possibly get by it till the blank is cut and it will operate with the press working continuously without slipping or jamming.

Fig. 1 shows the stop itself and Figs. 2 and 3 show a die and punch equipped with it. As the die shown is a follow die, it is necessary to provide a couple of auxilliary stops, as shown at *A* and *B*, Fig. 2, to start the stock.

In operation, the stop *A* is pushed in and the stock is fed to it, the press then cutting two half-blanks and piercing the stock for the succeeding two. This stop is then withdrawn and the second one *B*

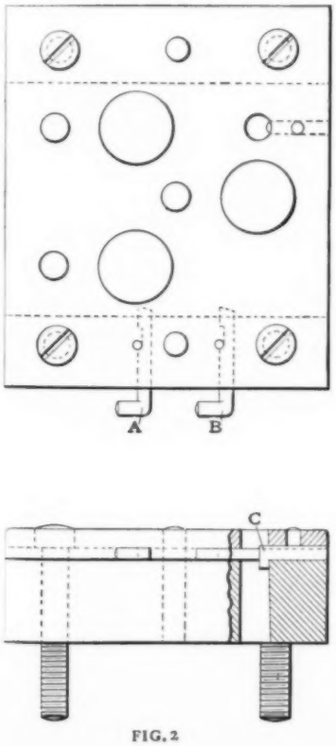


FIG. 2

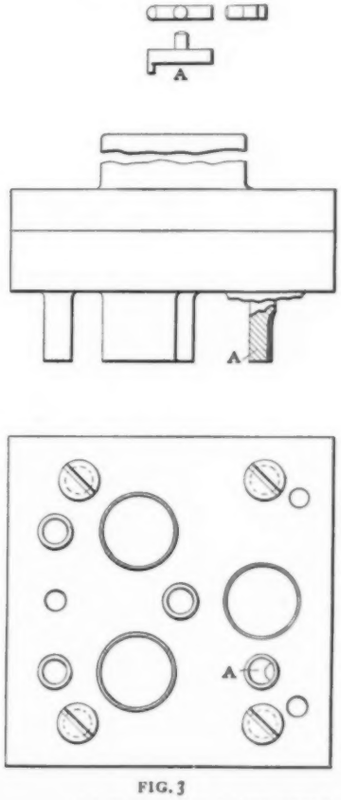


FIG. 3

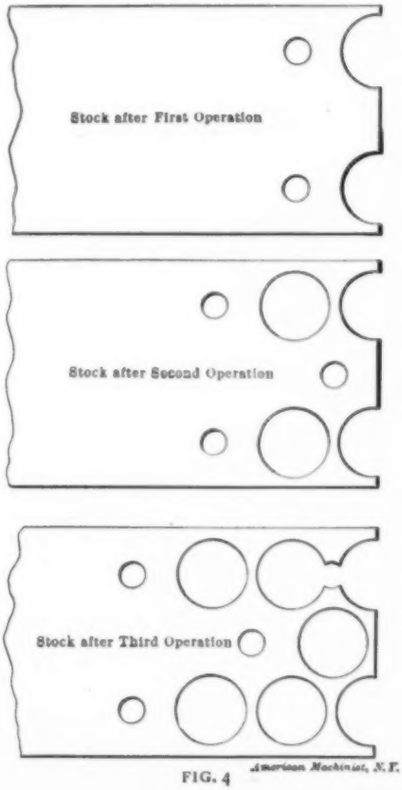


FIG. 4

STOCK STOP FOR PRESS TOOLS

is pushed in and the stock is fed up to it, the tool then cutting two perfect blanks and piercing the stock for three more. The stop *B* is then withdrawn and the stock is pushed up to the stop shown in Fig. 1 and again at *C* in Fig. 2.

Once at this point the stock cannot possibly get past this stop without cutting away the thickness of metal left between the two holes from which the blanks were cut previously, and for this purpose an extra punch must be provided, as shown at *A*, Fig. 3.

Thus it will be seen that it is only necessary to maintain a constant forward pressure on the stock and the stop will take care of the rest. Fig. 4 shows the stock as it appears after each operation has been performed.

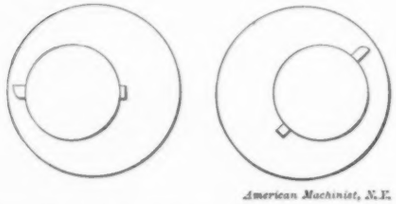
Montreal. V. EDGAR WALTERS.

Boring Straight Holes in a Lathe

Sometimes a machinist starting in at a new shop is given a job of accurate boring in a lathe that has a chronic inability to produce a straight hole. Having had several experiences of this kind, I have given more or less thought to the subject and will give the conclusions I arrived at.

Usually the trouble is caused by the spindle bearings being worn out of line with the ways, though sometimes the ways have been bruised or cut up badly enough to cause trouble. A single bruised spot may tilt the carriage enough to cause trouble, the remedy in this case being, of course, to locate the bruise and file or scrape it level with the surrounding surface.

In the other case the lathe should be



American Machinist, N.Y.

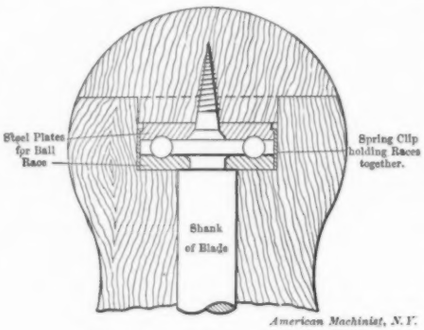
FIGS. 1 AND 2. STRAIGHT HOLE BORING IN THE LATHE

overhauled, but this is not always convenient as the boss may not want to lose time enough to do it. A kink I have found to answer the purpose very well is to change the position of the tool in the bore of the work being done. In Fig. 1 the tool is shown as it is ordinarily placed with the cutting point toward the front of the machine. In case the bore tapers, place the tool as shown at Fig. 2. It may be necessary to move the tool further around or else not so far, but a little experimenting will usually produce a hole straight enough for all practical purposes.

Littleton, Colo. BEN LANSDOWN.

A Handy Screwdriver Handle

When a man uses a tool a great many times a day he usually devises little attachments or kinks to lighten the work as much as possible. In assembling apparatus where a heavy screwdriver is required for screws in pockets or other inaccessible places, much time is lost; often the screw is dropped (and possibly the man's temper is "lost" also) by the necessity of removing the point from the screw



HANDY SCREWDRIVER HANDLE

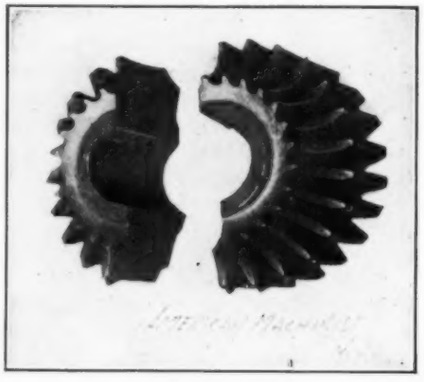
slot in order to get a fresh hold, the other alternative being to change hands and keep the screwdriver in place, but on most assembly work at least three hands are required to hold things in place.

These conditions furnish the reasons for the arrangement shown in the sketch, which consists in making the palm of the screwdriver handle to turn freely. The advantage of this is that after completing the forward turn the pressure of the palm can be maintained while the fingers are backed around for the new hold. A small ball bearing is shown in the sketch, but a flat plate bearing will be found equally serviceable if the balls are not easily obtained.

Rochester, N. Y. RALPH W. DAVIS.

Repairing a Broken Milling Cutter

The photograph shows a cutter which broke in two pieces as shown. It happened in this way: We got a rush order



THE BROKEN MILLING CUTTER

for a lot of 8-inch button pliers. Our cutters for this job were worn out so I had a high-speed steel cutter blank turned up, fluted and backed off in quick time and sent to the temperer. For some reason the cutter checked in tempering. The cutter was started on the milling machine and milled only a few forgings when it parted as the photograph shows. The order was due and something had to be done. I said I would fix the cutter and use it, which remark brought forth a good supply of chaff, of which I was temporarily the victim. I lost no time in tying the cutter together with a wire, placing it on a short arbor in a dividing head and setting the dividing arbor vertical on an adjustable table of a grinding stand. With a sharp emery wheel and by turning the crank of the dividing head, I soon ground away the cutter leaving a hub on each end as shown. Meanwhile I had a toolmaker turn up two collars to fit the arbor. These were made large enough and recessed on one end so as to just start over the hubs of the cutter. The cutter was soon rigid on the arbor of the milling machine; in less than three hours from the time that it broke, it was back on the same job. I had an account kept of the number of forgings milled after the cutter broke, and found that it milled 41,000 pairs of 8-inch button pliers before we discarded it. I will say that I believe we mill pliers as rapidly, too, as any of them.

Chrisman, Illinois. P. A. SCOTT.

Laying-off Centers

Fig. 1 shows a copper rivet *A* driven tight in a piece of wood *B* instead of the piece of sheet iron or tin with bent-over corners commonly used in laying out castings with cored holes.

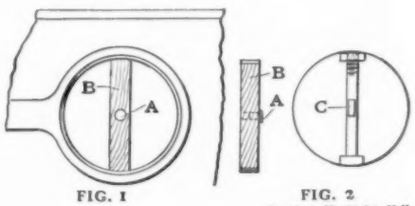


FIG. 1 FIG. 2

LAYING-OFF CENTERS

One can never be sure, on close work, that the flat tin does not move a little under the hammer blow.

Another method I have used on large work is illustrated in Fig. 2, which is a bolt with a flat spot at *C*.

Cleveland, Ohio. PAUL CAMPBELL.

According to *Power and The Engineer*, cast-iron standard fittings should be used only for pressures below 100 pounds, medium extra heavy for pressures from 100 pounds to 150 pounds, and extra heavy over 150 pounds.

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

How to Produce the Taper Punched Holes in One Operation

If your correspondent L. S. F., on page 744, will use an ⅛-inch punch and a 5/32-inch die, he will have no trouble in punching conical holes, except it will be necessary to have the punch set central, and the least defect in this will be shown by the punching. This same small punch and large die is a cure for the bending of the piece being punched, and the power necessary to do the work is only about one-half.

There is a good deal in this punching business, from the subpress work where the arms and rim of watch wheels receive a polished finish, to boiler and structural-steel work, in which the distortion of the metal around the holes is that which needs to be avoided to the greatest extent.

When a punch is enough smaller than the die so that the shear through the stock is 5 degrees, there is scarcely more strain put on the metal around the hole than when drilled.

JOHN E. SWEET.
The Artisan School, Syracuse, N. Y.

Referring to your inquiry, on page 744, if I had this proposition I should try punching with a ⅛-inch punch into a 5/32-inch die. If the metal is not too soft, this may give you the result you wish. It would not be expensive to make up one punch and die to try it out.

W. B. GREENLEAF,
Secretary Southern Stamping and Manufacturing Company.
Nashville, Tenn.

Several years ago I had occasion to do a job of the character described on page 744. I cannot exactly state the dimensions, but the job was very close to the one mentioned in every respect. The plate was first straightened and then inserted in an automatic self-feeding perforating press and punched with three sections of punches, about 20 in each line. The dies for perforating the plates were made as follows: The dies had a little more taper than usual, about 1¼ degrees on the side, and the holes in the dies were also from 0.015 to 0.020 inch larger than the holes to be perforated, which means that the punches were 0.020 inch smaller than the holes in the dies. The punches were also tapered, filed very smooth, had a solid spring stripper, and during the operation the plate was held down solid by the stripper on the dies. I never experienced any buckling on this work; of course, it always warps to a circle, but this can be overcome by rolling it straight if necessary. It may be that the cause of the trouble in this case is that the material is not right for this class of work. I would advise the use of soft pickled steel if possible, or it may be that there is not enough clearance in the dies. It is also possible that the punches are not loose enough in the dies, or that the stripper does not hold the work tightly to the surface of the dies. When punching I would advise the use of lard oil on both sides.

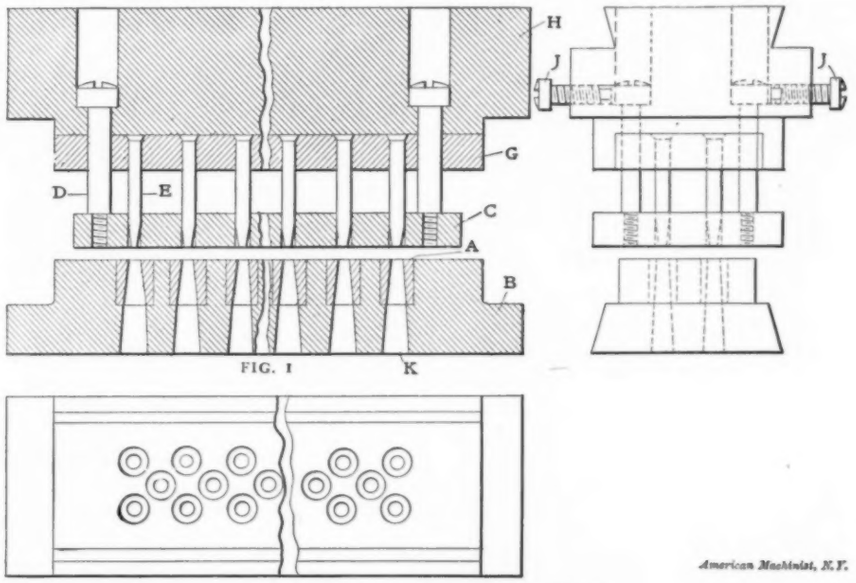


FIG. 1 PUNCH AND DIE FOR TAPERED HOLES

Figure 1 shows how the die was constructed for producing tapered holes. The bushings *A* represent the dies forced into the machine-steel holder *B*, which was reamed from the bottom, as shown at *K*, to prevent the punchings crowding in the shoe *B*. On a job like this the punchings usually crowd in the dies and shoe, and break the punches. *C* is the stripper held by the screws *D* and actuated by coil springs, not shown, over the screws *D*. The punches *E* were made in sleeves, not shown, and in case of breakage could be quickly changed and held in the punch plate *G* and fastened on the machine-steel punch holder *H*. The screws *J J* are required on every third screw, to lift the stripper when setting the dies. After the dies are set the screws *J* are loosened. A die of this kind will answer the requirements.

CHARLES EISLER,
Department Foreman, Hoefer Manufacturing Company.
Freeport, Ill.

A Shrink Fit Problem

Under the above heading, at page 769, J. C. Lemmens solicits suggestions regarding the amount of shrinkage required to give satisfactory results where rings are to be shrunk onto light 4-inch tubing, in which the finished product will in use be subjected to a "fairly high temperature."

No doubt there are machinists who are cock-sure they can tell to a thousandth part of an inch the required amount of shrinkage. But in view of the fact that the radial thickness of the rings, as compared with that of the tubing, may be a factor in estimating the shrinkage, a little experimenting would probably prove most satisfactory.

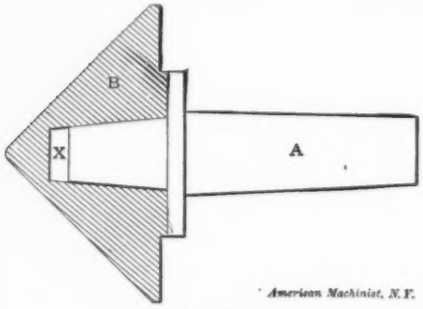
For if the rings are comparatively heavy, then too much shrinkage will not "cause ripples on the inside of the tube," but reduce the size of the tube, perhaps beyond that allowable, while if the rings are comparatively light, and, when being placed, at a higher temperature than the tubes, they will, if within reasonable bounds as to size, "give" sufficiently to accommodate themselves to the tubes, and with all the tension obtainable under the circumstances.

The chances are, however, that the whole proposition is impracticable, if shrinkage only is relied upon, for it is well known by mechanical engineers that a metal ring, shrunk on tubing (as in the case of pipe fittings), when heated together, becomes loose on cooling. And if the product above referred to is to be subjected to any considerable amount of heating and cooling it is likely the rings will require to be sweated to the tubes with something in the nature of brazier's spelter to retain them in place.

Quincy, Ill. J. R. LITTLE.

Pipe Centers

Referring to the article "A Ball Bearing Pipe Center" on page 468, I have made centers that keep in good condition after years of service. They are easily made and at very little expense, in the following



A PIPE CENTER

manner: A piece of mild steel *A*, turned one end to fit the lathe spindle, a collar to take the thrust and each lathe fitted with a pair. Then I have in stock several pairs of different sizes of cast-iron centers *B*. Let the bored holes in *B* fit well on the end of the spindle *A* with ⅛ inch of clearance at *X*. A good practical revolving pipe center is the result.

Old Hill, England. A. B.

Grinding Milling Cutters

The article on page 630, by J. B., showing a kink he uses to grind cutters by hand seems to be a good one. When I receive a gear cutter from the makers, the first thing I do is to put it on a mandrel and between centers and use a test indicator to test every tooth on the cutting edge, as shown in Fig. 1.

Almost invariably the teeth show a variation of 0.002 to 0.005 inch. I then mark all the high teeth. Next I mount the cutter on an arbor which fits in the spindle of the head or milling machine, using a disk wheel whose face has been set in the center of the spindle or cutter. The gage finger is then brought up against the back of the tooth at *A*, then grind off all high teeth on the cutting edge or face at *B* and continue until all the teeth indicate the same hight. I use the finger for feeding the tooth up against the wheel, thereby maintaining all cutting-edge lines through the center of the cutter.

When all the teeth show the same hight, by merely tapping out the arbor with the cutter mounted, I put it between centers as before and use an indicator to prove that all teeth show the same hight.

The cutter is now reversed on the arbor and the backs of all the teeth ground to

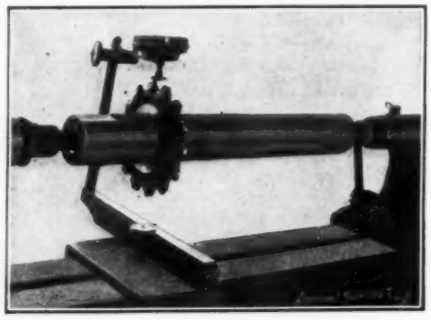


FIG. 1. TESTING A NEW CUTTER

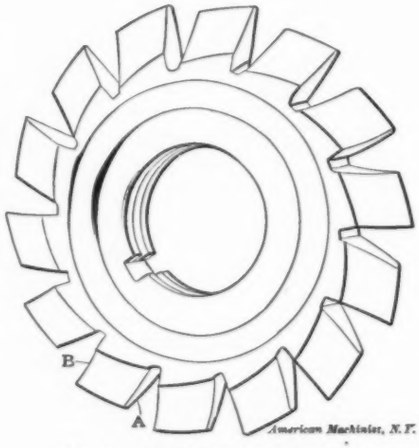


FIG. 2. CUTTER TO BE TRUED UP

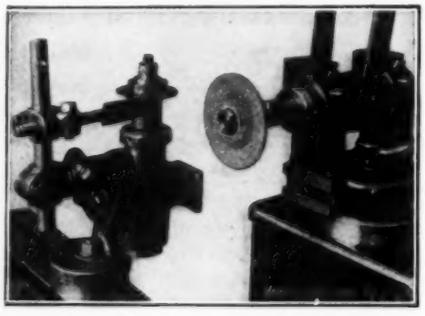


FIG. 3. GRINDING THE CUTTER

correspond with the true cutting edge or surface, by bringing the finger against the surface of the tooth. The cutter is now put in the tool-room rack ready for use. In resharpening this cutter, it can readily be seen that it requires no further testing for the next four or five sharpenings, just bring the finger up against the back of the teeth and grind in the usual way.

Milwaukee, Wis. J. G.

Calibrating Pyrometers

Mr. Dogecla on page 588 says that in a previous letter I suggested the observation of the melting points of certain salts guaranteed for accuracy by a responsible chemist, and he complains that I do not tell of an easy way in which to observe these melting points without taking considerable time and going to considerable expense and trouble.

Since my letter appeared no doubt Mr. Dogecla has read the article by W. H. D. of this city, appearing on page 502, which gives a detailed account of all the labor and outfit required for the accurate calibration of pyrometers in the method I had in mind when writing my previous letters. The method described by W. H. D. is quite inexpensive and not laborious, and the complete calibration is not by any means a long process.

I would suggest, however, the substitution, where gas is available, of a small concentric jet furnace of the kind made by Messrs. Fletcher, Russell & Co., Ltd., Harrington, England, for the portable smith's hearth. These little furnaces are very handy in every way, and lend themselves to the job far better than a smith's hearth, and they have the advantage of being far more portable, as they weigh only a few pounds. They can be used successfully with a pair of foot-bellows, but, of course, if compressed air is available it is far less labor, and much more satisfactory, to use it. With a blast of about three pounds it is possible to melt high-melting point salts in a comparatively short time, and the ordinary points for calibration present no difficulty whatever. The first cost is from $4 to $5, depending upon the size.

The method of checking suggested by Mr. Dogecla, and also advocated by W. H. D., is very simple, but I do not think it at all suitable for the original calibration of any pyrometer. It is difficult to tell if Mr. Dogecla offered the method as a means of calibration as well as checking. As a check it is very useful and cheap, and a quick method of weeding out instruments which have "gone off" during their work.

I do not think it at all safe to trust the selection of a suitable pyrometer for a particular class of work to any maker of the instruments. Whether his reputation is good or bad, it must be remembered that any maker will only try to sell you his instrument, and that may be far from the best on the market. I think the best way to make a selection is to go and see as many different kinds of pyrometers as possible, read up all the catalogs, and let the agents know you are on the market for buying. After a month you will know the best instrument, especially when you have obtained all the verdicts of different users about the country.

Sheffield, Eng. W. CORAM.

Making a Set of Blanking and Piercing Tools

The article under the above heading, by H. Harris, on page 480, of the AMERICAN MACHINIST, excited my interest; but there are several points in his method of procedure that invited criticism from one familiar with this class of work.

First and foremost is the cost of making the three templets necessary to his method, which is obviously quite a proposition in itself, for to be of service in turning out accurate tools, the outlines of both male and female must be alike and a fit, the piercing holes in both must agree in pitch and in relation to their respective outlines; then, too, the hardened blank or drift requires to be slightly but uniformly smaller than the male templet proper. All this requires careful and time-consuming work to produce. This is especially the case of an irregular shape as shown, that cannot readily be made to direct contact measurements.

However, assuming the templets to be made, it does not seem to me that sufficient use is made of them, for Mr. Harris transfers his piercing holes in both the guide-stripper and the punch-plate from the die. This might be done without any great possibility of inaccuracy in the case of the guide-stripper, but the die and punch-plate must necessarily be some distance apart when clamped together as described for transferring, allowing the drill or reamer to run pretty much where it will. My judgment is that better results would be obtained by transferring the piercing holes in both the punch-plate and the guide-stripper directly from the female templet, in the manner described in the next paragraph.

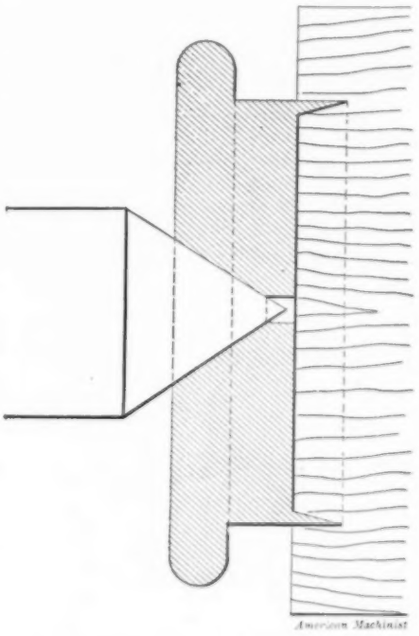
In putting the holes in both the guide-stripper and the punch-plate, finish the outline for the punch as described, enter the punch through, so as to project from both sides, slip the female templet successively over each projecting end of the punch, and drill and ream from each side of the holes to meet in the center, thus reducing to a minimum the possibility of the holes running. In the case of a reversible blank, and to guard against any faulty positioning of the holes in the templet multiplying itself in transferring, it would be necessary to mark the templet when drilling the die, so that in subsequent transferring to the other members of the tool, corresponding holes shall be located from corresponding holes in the templet.

Exception might be taken to this method on account of the possibility of the holes in the die changing pitch or location in hardening; but with careful annealing and hardening this should be negligible, should such change be feared it could be provided for by leaving a lapping allowance in the holes, and correcting them after hardening by lapping with a stepped lap, whose largest diameter is a close running fit in the guide holes in the guide-stripper and charging only the lower portion with the abrasive.

Manchester, England. GEORGE E. GAY.

Pattern Shop Appliances

Perhaps James Brown will pardon me for suggesting what seems to me to be an improvement on his clamp dog described on page 621. The cut will make the idea plain.



A METAL CENTER FOR PATTERN WORK

This arrangement would give a metal center for the lathe center to work in. To fix it in position use a steel center punch made to fit the small center hole. Slip it through the clamp, put the point into the wood, slide the clamp into position and tap it with a mallet.

Bedford, England. HAROLD SMITH.

A Shrink Fit Problem

At page 769 G. J. Lemmens raises a shrink-fit question which I wish briefly to discuss in an effort to help him with his problem.

He desires to grind the inside of the tubes he mentions very close to the finish size before the rings are shrunk on them, and desires that the resultant deformation of the tubes from shrinking on the rings shall be so slight that a lapping process should suffice in obtaining a perfect interior for the tubes.

He says, however, that "a slight deformation would not be serious, since if necessary the tubes could be reground to remove this," and I believe that herein lies the solution to his question. Since he does not give the dimensions of the rings to be shrunk on the tubes this point is left to conjecture in supplying a method of procedure.

With the above quotation from his inquiry in mind, and assuming that the rings are of sufficient strength to withstand a good "bite" on the tubes, I should attempt to solve that problem as I have similar ones by making no effort to grind the tubes so near to size until after the rings are shrunk in place.

I should first take one tube and ring for trial and leave about 0.005 inch in the interior of the tube to be ground after the ring is shrunk on. I should make the inside of the ring 0.004 inch smaller than the outside of the tube and heat the ring slowly and uniformly to a temperature sufficient only to pass it over the tube. After shrinking on and when cool I should satisfy myself that the ring was in place to 'stand the requirements by subjecting the whole to the heat it would likely have to withstand and still be tight, and by making such other tests for its tightness as would possibly be met with ultimately.

If satisfied as to its tightness I should then proceed to grind the interior of the tube and lap to the exact finished size and then put the lot through in a similar manner without a thought as to any "aging" effect, since if such should occur to seriously affect the job in question the idea of shrinking the ring and tube together in any manner is wrong, and another method should be devised to accomplish the desired end.

That it is better to prove one piece before attempting to take the lot and work to someone's theory and possibly get the entire lot of rings too loose on the tubes is, I think, manifest.

If in time, as he believes might happen, ripples appear on the interior of the tubes from excessive pressure of the rings (which I do not believe is probable), it would seem that such slight deformation in the tubes could be remedied by another lapping.

Whether or not Mr. Lemmens wants to bring the interior of the tubes as near to size before the rings are shrunk on them, I should consider that if I had the job before me and should attempt to bring the size so near that it would only need to be lapped to its final exact finish after the ring was in place and get out the lot to the same dimensions, I was taking a pretty stiff chance on losing some of them. Better to "make haste slowly," and if possible, after satisfying oneself that the ring and tube are secure grind and lap to size, for a bad shrink fit would put the job on the scrap pile.

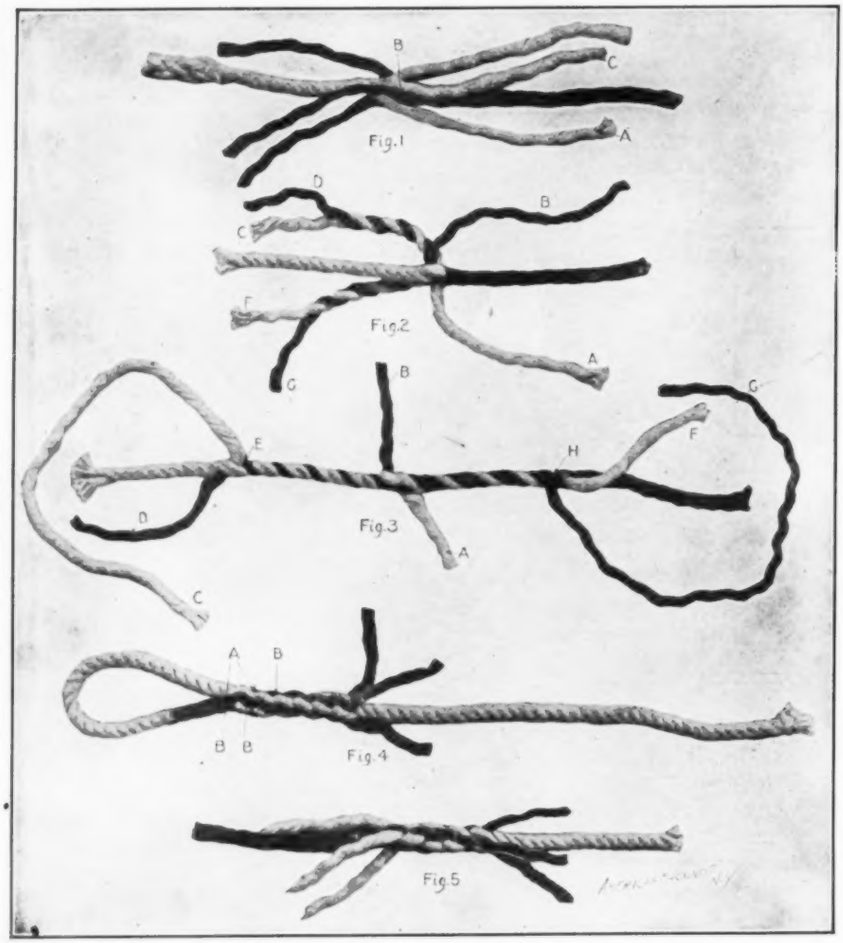
Cleveland, O. H. R. G.

An advance chapter of "Mineral Resources of the United States," issued by the Geological Survey, shows the mineral output for 1908, $1,595,670,186 as against $2,071,607,604 for the previous year.

Splicing Wire and Other Ropes

By J. Watt

The short splice is, as a general thing, better known than the long splice, and I have often heard landsmen say, "I can make a short splice but not the long splice as it is so much more difficult." This is not true; the one is as easy as the other, and while they are probably equally strong there are many places where a short splice cannot, because of its larger diameter, be used; for instance, in a fall where the rope will just pass through the blocks.



SHORT, LONG AND EYE SPLICES IN COTTON ROPE

The First Step

Unlay the rope ends as far as desired. The rope used for the halftone reproductions, Figs. 1 to 5, was common cotton clothes line about 3/8 inch diameter, and was unlaid for about 6 inches, although it is not necessary for a short splice to unlay so far, as a splice is in length equal to nearly twice the length of the part unlaid. One part of the rope used for the cuts was dyed to make a contrast between the two pieces being spliced.

The Second Step

The two ropes are then in sailor language "married," as shown in Fig. 1. The two ends are brought together so that the ends of one rope lie between alternate strands of the other. If a short splice, as shown in Fig. 5, is to be made, a string can then be tied around the ropes at the point where they meet, so as to keep them in place.

The Beginning of a Short Splice

Take any one of the strands, for instance, the white one marked *A* in Fig. 1, lay it over the first black strand to the left marked *B* and under the second black one to the left, that is, the one just behind the white strand marked *C*. Then take the next white strand and pass it over the next black strand to its left and under the second black strand to its left. Repeat with the third white strand. Then turn to the black ends and repeat the same operations carrying the black and white ends along in the same way till the splice looks like Fig. 5.

If a very neat splice is not wanted the ends can be cut off at this point, but if a neat splice is wanted, take each strand end in turn and unlay half of it back to where it passes under the last part, cut one half of it off at this point but be careful to cut the half *next to the rope*, so that the half which remains will, when laid over and under once more cover the cut ends. Repeat this with all the ends splicing over and under either once or twice. Then cut the strands in half again and repeat as before. This will give a nicely tapered splice which is much more sightly than the one referred to before.

The Eye Splice

The eye splice, shown in Fig. 4, is made in the same way. For clearness I dyed the end of the rope black. The ends are unlaid and the size of eye being decided upon the end is brought around and if desired can be tied in place with a piece of string. The three ends are one at a time brought under the three strands of the rope, each one under the strand which comes nearest to it. The run of the strands is shown in Fig. 4 at *A A, B B B*. They are then passed over a strand and under one just as described before. The ends can also be tapered off in the same way.

The Beginning of a Long Splice

After the two ropes are "married," as in Fig. 1, they are, for a long splice, arranged as shown in Fig. 2. One pair, a black and a white, are tied in a simple overhand knot, as shown by *A* and *B*, Fig. 2. The other ends are twisted together, as shown, in pairs. This twisting is done to keep them in place, and while not necessary in this case (a light three-stranded rope), shows how to do it in the case of a heavy six-stranded wire rope which is shown later.

The Next Step in a Long Splice

The next step is to untwist from each other one of the pairs, say for instance, *C* and *D*, Fig. 2. The white strand *C* is then unlaid from the white rope to the left and the black strand *D* is laid in its place. When this has been done far enough, say 6 inches in a small rope, an overhand knot is tied in the two at *E*, Fig. 3, just the same as was tied by *A* and *B* in Fig. 2 (shown in the center of Fig. 3).

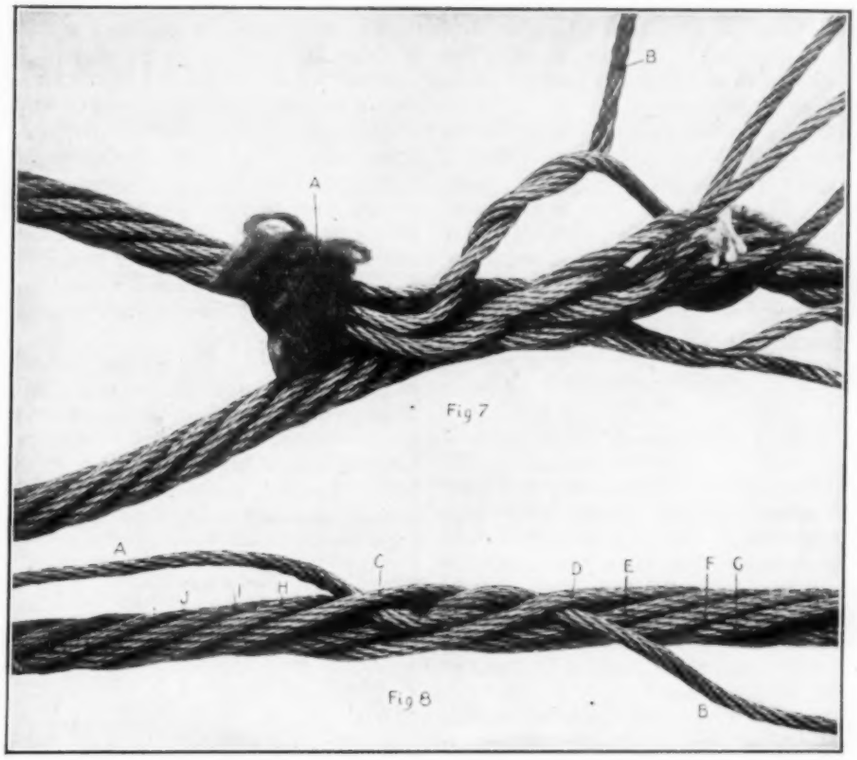
Then the two strands *F* and *G* are untwisted and the black strand *G* is unlaid from the black rope at the right and its place is filled by the white strand *F* until at 6 inches from the center another overhand knot *H* is tied. We now have the splice in the condition shown in Fig. 3, and all that remains is to fasten the ends of the strands off. We proceed exactly in the same way as we did with the short splice over one and under one strand with both the black and white strands, tapering the ends for a neat job.

Splicing an Eye in a Wire Rope

Wire rope has, as a rule, six or more strands and a core of tarred hemp in the center. The splicing of an eye in a six-strand wire rope is an entirely different proposition from splicing one in a three-

or four-strand hemp or cotton rope. The end of each strand is prevented from unlaying by binding it with a piece of wire or string. The length to be unlaid is then determined and a piece of string or wire is tied around the rope at this point, as shown at *A* in Figs. 6 and 7. The strands are then unlaid to this point, the hemp core cut out and a marline spike (pointed piece of round steel) is passed through the center of the rope where the first strand is to be put through. The marline spike is withdrawn and the first strand is passed through the center of the rope; thus there will be three strands on each side of it. The second strand is then passed into the same hole, but it is brought through between the second and third strands of the rope. The third strand is then passed under the first strand of the rope. The remaining strands are passed with the aid of the marline spike, each under a separate strand of the rope. In this way we have a strand coming out between each adjacent pair of strands of the rope.

In splicing an eye in a wire rope the procedure is now different from that used for hemp. Instead of passing the unlaid strands over one strand and under the next the unlaid strand *B*, Fig. 7, is passed several times around the strand it is first passed under. In Fig. 7 the rope is opened out to show the run of *B*. The strands can be reduced in size (first removing the core) as the work goes on, so as to taper the splice. With wire splicing a good, heavy pair of pliers and a hammer and anvil or block of iron will be found useful to hammer the splice into shape. After being finished the eye splice can be covered with canvas (called parcelling) and wound, on top of this, with tarred marlin (called serving). These are, however, details which have nothing to do with the splicing itself.



DETAILS OF WIRE-ROPE SPLICING

Making a Long Splice in a Wire Rope

This is used for endless wire cables or joining wire ropes together. The individual strands on the ends of the wire rope which it is desired to make double, or the wire rope which is broken and is to be repaired, are secured by binding with wire or string as stated before.

The length of the splice is settled on. The rope shown in Figs. 6, 7 and 8 is ¼ inch diameter, and 18 inches was unlaid from each end. One-half this length is marked off on each end of the wire rope to be made endless, or the parts to be joined.

Both parts are wrapped with wire or string at the marks and the strands are unlaid up to this binding. The hemp core is then cut off at this point. The two parts are brought together and "married." All the strands are "mated" and wound around each other, as shown in Fig. 2 at *C D* and *F* and *G*, except one pair. As wire is generally too stiff to make a snug overhand knot, we bring these together the best we can, dip the one under the other, as shown in Fig. 8, and in order to prevent the unlaid strands from coming loose, we tuck each one of them under the next strands *C* and *D*, as shown. Previous to tucking the strands *A* and *B* under *C* and *D* the strands composing *A* and *B* can be carefully unlaid and the hemp cores cut out back where *C* and *D* are twisted around each other. After passing *A* under *C* and *B* under *D* the end *A* is passed over *H* and under the next *two* strands *I* and *J*. The same thing is done with *B*, passing it over *E* and under *F* and *G*. The finish in a wire-rope splice is over one and under two, over one and under two till finished. The wire can be tapered off as previously described.

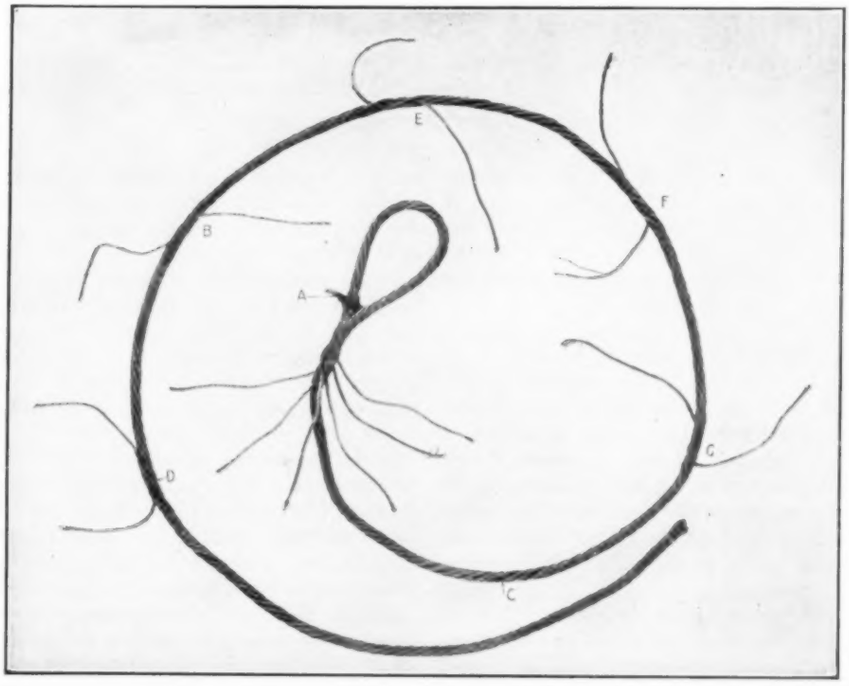


FIG. 6. AN EYE AND A LONG SPLICE IN A WIRE ROPE

Practice is everything in the making of a neat splice in wire rope. Flexible wire ropes from ⅛ to ½ inch diameter can be bought in any large city and are excellent to practise with.

The long splice, shown in Fig. 6, reaches from *D* to *C* and is 2 feet 5 inches in length. The rope used is ¼ inch diameter. The ends at *C*, Fig. 6, have been partly finished off, while those at *B E F G* are in the same condition, as shown at the center in Fig. 8.

Molding Large Drum Shell with Spiral Grooves

By L. F. Cook

There are few pieces of work that enter the pattern shop and foundry that require the amount of time to prepare and mold that is met with in large drum shells, as their size compared with their weight makes them a difficult proposition for the foundry to handle. When I say large drum, I mean shells ranging in diameter from 10 feet upward.

To mold the job both inside and outside in brick and loam requires much pattern work, made up of innumerable small pieces, which must be bedded in the loam in their respective places, and unless a patternmaker is in the foundry to do this locating the result is not very satisfactory. In building the core in brick and loam unless ample provision is left for contraction, which is frequently overlooked, the result is a cracked or badly strained casting.

The accompanying line drawing shows a large spiral-grooved drum that we recently made by using a combination of brick and loam for the outside, and sectional dry sand cores for the inside.

In Fig. 1, *A* is a view of the outside of the drum showing the spiral grooves and brake band that is cast on the top flanges, while *B* shows a sectional view of the drum with the reinforced ribs on the inside. In Fig. 2, *C* is a sectional view of the outside of the mold with the sweep in position ready for sweeping the spiral grooves, which will be described in detail later, while *D* is a sectional view of the mold complete, with the cores in position.

After leveling bottom plate *G*, which has a taper hole in the center to receive the spindle *H*, we used a plain sweep to strike the bed along the line *I I I* that forms the seat for the lifting-out ring *J*, which is provided with four eyebolts *K*. In striking up the bed along line *I* we bedded in the ribs *L* on the bottom of the casting. After making the parting for the seat for the lift-out ring *J* we set it in position and struck the bed up level with the parting.

To make the main body cores *M* we used a ⅛ circle box, with the section of the bottom and top flanges pinned to the inside ends and the reinforcing ribs arched across the face of the box. We also ran a riser and its sprews to the bottom flange, and to each of the lines of ribs, as shown at *E* and *F F F*. These cores *M* were set in place in the bed of the lifting ring *J* by using the finger sweep, shown in Fig. 3, to line them with.

We next bedded in the binder ring *N* to keep the cores from overbalancing, and prevent their shifting. On top of this we set the upper cores *M'*, eight in number, that form the top of the upper flange, the inside of the brake band and a small sink head on the top. This core was also gaged with the finger sweep.

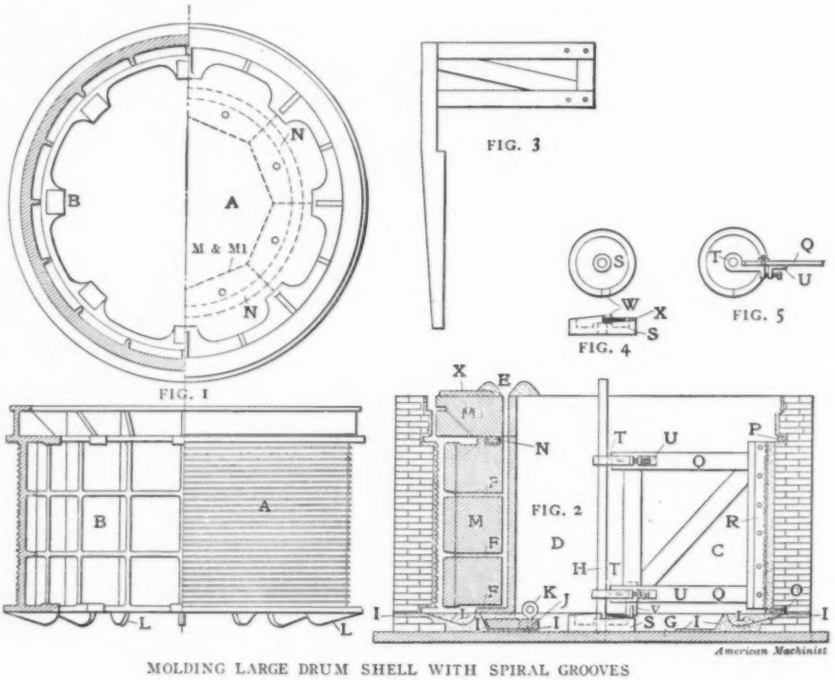
After having the cores set and anchored in position we lifted out the ring *J* with its cores *M* and set them on the core-oven truck. We next built up the brick and faced it with loam after bedding in the bottom flange *O* and top flange *P*, which were in segments, using a sweep to conform to the line of the mold, as shown. On the face of the mold where the spiral grooves were to be cut the loam was put on sufficiently deep to enable us to cut the grooves and leave enough loam outside the brick to form the mold.

After it had set sufficiently to cut well we mounted the sweep *Q* on spindle *H*. The cutting edge *R* was made of ⅛-inch steel plate, cut to the proper shape for the rope. In order to get the spiral thread to the grooves, we used the jig *S*, shown in position in Fig. 2, and alone in Fig. 4. This consists of a ring about 18 inches in diameter, and on top of the rim was cut a spiral equal to the pitch of the grooves, as shown at *X*.

The center of the jig was bored to fit neatly over the spindle *H*. The sweep *Q*, Figs. 2 and 5, was mounted on the clamps *T*; the bolts being drawn sufficiently tight in the slotted holes to hold it in place, but to allow it to slip when the feed screws in angle *U* were screwed up.

The clamps *T* are bored to a sliding fit on the spindle. The sweep with its fittings is supported on bracket *V*, which has a roller in the bottom and traverses the spiral edge of jig *S*. In order to enable the sweep to cover the full circumference it is necessary to have a loose block *W* for the roller to run over at the start and under at the end of the swept circle. For each revolution the sweep is screwed out by feed screws to give it the proper cut until the grooves are cut their full depth.

When the grooves are cut the mold is dressed and blackened, and the whole put in the oven to dry. When dry the mold is set level in the pit, the cores lowered in place, the center and outside rammed in, and the anchor plate put on top of the cores and weighted. A runner was made around the mold so as to catch the risers and feed them all properly with an even flow of iron.



MOLDING LARGE DRUM SHELL WITH SPIRAL GROOVES

While this may not be a new way of handling this class of work, it was the first time it was used in this foundry where a number of drums are made, and all agree it was the best, cheapest and most satisfactory that they had ever tried.

In the *English Mechanic and World of Science* it is noted that to prevent the formation of rust inside boilers, experiments have been made at the Berlin Technical Institute, Germany, to use water deprived of the air it contains by means of charcoal. Sacks of freshly prepared charcoal have been put into the water from which the boilers are fed, and the decrease of rust in the boilers fed with this water has been about 25 per cent.

Giving a Patent for the General Good

The Link Belt Company Presents Herewith a Valuable Patent to the Mechanical World, Rather Than Exploit It or Play Dog in the Manger

EDITORIAL CORRESPONDENCE

The regular readers of the AMERICAN MACHINIST will probably recall an article in the issue of February 23, 1905, entitled "The Ball Expansion Drive Stud," which illustrated a development in the practices of the Link Belt Company, of Philadelphia, of a method of what may be termed "blind riveting," for the purpose of securing flanges to the sprockets used in connection with the Renold silent chain.

This may be more readily brought to mind by referring to the illustration, shown at *A*, *B* and *C*, which shows a section of a piece before and after riveting. The rivet or stud is a plain piece of stock having a hole drilled in one end, with a chamfer surrounding the hole and then cut off from a bar of cold-rolled stock. This is obviously a job for the automatic screw machine and is a very easy piece to produce.

A hard-steel ball, bought at a very low price from the culls taken from the balls selected by makers of bearings, and slightly larger than the hole in the end of the stud, is dropped into the hole ahead of the stud, which is then driven into place over the steel ball, as shown at *B*. The chamfered end of the stud aids in closing it around the ball.

It can readily be seen that the amount of expansion on the lower end of the stud depends upon the difference between the diameter of the hole and that of the ball,

AMERICAN MACHINIST,
505 Pearl Street,
New York.

Referring to Mr. Hill's inquiry as to the efficiency of the ball expanded drive stud he saw in use in this shop would say that we find these about as strong as bolts of the same diameter—they are in to stay. Yes, it is patented.

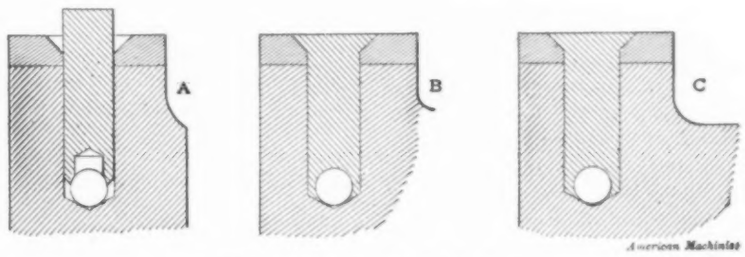
This drive stud, or blind rivet, has been of great use to us and saved us many dollars. We own the patent on it. It is something we might sell or otherwise exploit, but this is not our business.

We would like to present this patent to the mechanical world and will do so here and now through the AMERICAN MACHINIST.

We give it for the benefit of any and all who desire to use it and agree never to claim any rights, royalties or renumerations for it.

Hoping that it will be as valuable to other machinery makers, as it has been to us.

LINK BELT CO.,
James M. Dodge, President.



THE BALL STUD AND THE WAY IT IS USED

and extended reference to this was made in the article in question.

Sketch *C* represents the effect of a ball being considerably larger than the hole and shows the distortion of metal around the lower end, or the stud might be made to assume this shape if it were thought best to undercut the hole with a wabble drill for special purposes.

Practice indicates that the diameter of the hole in the end of the stud be about three-quarters of the outside diameter, that the depth of the hole in the stud should equal the diameter of the ball and that excessive driving weakens rather than increases the hold. We also find that the depth of the hole in the casting should be about twice the diameter of the stud for small sizes and 1½ times for large sizes, while the variation in diameter between the ball and the hole in the stud will naturally vary with the size of the stud, but is usually between 1/64 and 1/32 inch.

The following proportions represent the present practice of the Link Belt Company for small-size studs, which will save others the time and cost of experimenting along this line.

	In.	In.	In.
Diameter of stud	¼	⅜	½
Depth of hole	¼	⅜	½
Size of ball	9/32	13/32	17/32
Diameter of center bore	1/16	3/32	1/8
Depth of center bore	1/16	3/32	1/8

Tests have shown that 3/16- and ¼-inch studs are about 20 per cent. stronger than bolts of the same diameter, and the average grip of a ⅜-inch stud is nearly equal to the breaking strength of a bolt of this size.

Although this is a patented device and has been manufactured by them for some time, they have decided to forego all of their rights under the patent laws, and to give its free use as a contribution to the mechanical world at large through the columns of this paper, as can be seen from the letter of President Dodge on this page.

The Surface of Bearings

Rules and laws are rather delicate things to fool with for you no sooner lay down a set of either and prove conclusively that no one can do thus and so, than some inconsiderate chap comes along and does that very thing—probably because he never heard of your law or is a born skeptic anyhow.

But there are a few things we are fairly sure of, and one of them is that, as a general rule, a bearing runs better when the "grooves" in the bearing parts run in opposite directions. "Grooves" isn't just the word, and yet it fits the case better than "grain," which may be all right in some cases.

Take an engine-shaft bearing that has been running hot, and score or groove it lengthwise of the shaft with a coarse file and see what happens. Ten chances out of nine it will run as well as when new. The grooves catch and hold the oil, and the narrow tops of the grooves wear down to fit the inequalities of the shaft instead of holding it on a few high spots as with a solid bearing surface. This is why a shaft hanger with a broached bearing runs so well. The slight scores hold the oil and make a fine bearing.

In the same way a piston and cylinder wear in better with circular scores in the cylinder, as from a boring tool, than as if the scores ran lengthwise of the cylinder. This would not only allow steam or gas to pass by the rings, but would not hold the oil to lubricate nearly as well. This is why some engineers prefer a new engine to have a cylinder that is not bored too smoothly. The ridges hold the oil and the tops soon wear down to a fine bearing.

It certainly seems as though the glaze obtained from wear was the best possible surface for a cylinder and its piston.

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Giving a Patent for the General Good

We are pleased to call attention to the interesting and unusual letter of James M. Dodge, president of the Link-Belt Engineering Company, Philadelphia, Penn., in another part of this issue.

Among physicians it is considered unprofessional to patent o. otherwise monopolize any invention that may be made for the advancement of the art. While this is hardly possible in a general way in commercial lines, there are many cases where this can be done to the material benefit of the general good without causing a serious loss or inconvenience to the inventor.

There can be no question as to the advantage of the interchange of ideas which has taken place in the building of machine tools and other machinery and its effect in the advancement of the business to the present proportions and standing.

At the same time there are many patented devices which are rarely or never used by the patentees and yet are held out of general use with a dog-in-the-manger policy, royalties being refused in many cases, when a free use of the device would greatly benefit the business as a whole without materially injuring anyone concerned. We feel that Mr. Dodge is to be congratulated on taking the broader view and trust that it will prove an incentive to others, who are similarly situated, to follow suit.

The Need for Intelligent Inspection

No one would think of denying that a thorough system of inspection is a good thing for almost any shop and that this plan of looking after the quality of work is largely responsible for the extreme accuracy and duplication which is obtained in many manufacturing establishments. But, as with all other good things, it is subject to abuse and we feel sure that many will agree that there are too many cases of inspection gone mad, where work which is practically and commercially perfect is ruthlessly rejected.

A really intelligent inspector requires more than good instruments; he needs a good supply of common sense and judgment to use in connection with his micrometers and snap gages. And unless this combination exists, he loses money for the employer and imposes unnecessary hardships on the men who do the work. Just as the purchasing agent should know more than the difference between 99 cents and a dollar, so the inspector should know more than to detect the slightest variation from the standard size.

Leaving out of the question the difference in touch between inspectors, which really amounts to more than many imagine, and suppose for the sake of argument, that all measured exactly alike, there is still room for objection to some of the methods in use, where the inspector becomes a part of his instruments and is not allowed to exercise any judgment that he may possess.

Taking the case of a six-throw automobile crank shaft, and we have a forging, usually of alloy steel, with 10 journals, 4 main and 6 crank-shaft bearings. The drawing calls for a limit of half a thousandth of an inch in all these bearings, and if the inspector finds a single bearing out of the 10 with a thousandth variation, the crank shaft is rejected. This means a loss of from $50 to $60 to the maker of the crank shaft in spite of the fact that it is just as good commercially as the rest and that it could have been used with almost no extra trouble, and that no one could detect the difference after a month's running. In too many cases the crank shaft which is rejected if made by an outside party would be used if it had been made in the same shop.

In one case where a set of the Swedish gages was installed in an inspection room it was found that work was being rejected which was a ten-thousandth out when it would have answered equally well within a limit 20 or more times as large. It was not the fault of the gages in any way, but in the way they were allowed to be used.

Some of this probably comes from the employment of inspectors to whom it would not be safe to grant any discretion, but in such cases it would be better to have limit gages with as wide limits as the character of the work will ordinarily permit and to have rejected work looked over by an inspector with power to discriminate between vital and unimportant dimensions. In other words, judgment in real inspection is just as important as elsewhere, and it will pay to have first-class men who can prevent an unnecessarily high percentage of defective pieces which are usually absolutely wasted in work and material.

Even when the work is bought from outside parties, fair and consistent inspection pays just the same, for where the slightest pretext is used to reject work, the maker must make his price enough higher to guard himself against loss from this source as the best men and machines sometimes make a slight slip as to size. But whether the maker ever gets back at you or not, it leaves a better feeling all around, with yourself as well as with the other fellow, to know you have played fair and have treated his work as you would like to have yours treated.

It all comes as the result of our constant working with the finest measurements until, knowing how closely exact dimensions can be followed, we forget that there is often no necessity for anything closer than a few thousandths on a large part of the work.

New Publications

THE TWENTY-SIXTH ANNUAL REPORT OF THE BUREAU OF LABOR STATISTICS. 394 5¾x8¾-inch pages. New York State Department of Labor, Albany, N. Y.

This report is for the year ending September 30, 1908, and is sub-titled "Part I Industrial Training." The work of preparation has been done by Charles R. Richards, director of Cooper Union. The scope of the book is best outlined by quoting the chapter headings. These are: General Summary; Conditions of Entrance and Advancement in Individual Industries; Attitude of Labor Unions Toward Industrial and Trade Schools; Comments by Employers on Industrial Training; Rules and Agreements of Labor Unions in regard to Apprentices and Helpers; Laws of New York State Relating to Child Labor, Compulsory Education, Apprenticeship and Industrial Education; Institutions Offering Courses in Industrial Training in New York State.

As the investigations upon which this report was written were State wide, all of the important industries of the State have been investigated, through the agency of special investigators connected with the bureau. The object of the investigation was to determine the general relation of supply and demand in regard to skilled labor in the principal industries of the State, the conditions under which boys and girls enter the industries and their chances for advancement, together with the opinions of both employers and employees as to the value and need of industrial training outside of commercial establishments. The industries selected for investigation were those representing the prominent skilled trades and important mill and factory industries employing low or medium skilled labor. No industry was examined, with the exception of paper novelty work, that is not represented by over $3,000,000 of capital and 1800 wage earners. A brief summary of the main conclusions of the investigation is:

"1. The need of skilled male labor in the industries of State is reported most severe in the manufacture of blown glass, many of the machine and metal trades, the manufacture of furniture, the manufacture of boots and shoes, the printing trades, and in certain of the building trades. For females the need is reported most serious in the manufacture of silk, carpets, braids and embroideries, and in the machine-operating trades.

"2. The apprenticeship system in such industries as machine and printing trades and certain of the building trades is capable of being made more effective and a larger instrument of training skilled employees by the introduction of definite provisions for systematic instruction.

"3. The need and value of general industrial and preparatory trade schools for boys and girls between 14 and 16 years of age is emphatically testified to by employers in all the industries and agreed to by the labor unions.

"4. Practical trade schools seem to be most in need and to give promise of most practical results in the machine and building trades. Such schools are strongly urged also by employers in the boot and shoe trades, furniture manufacture and the printing trades.

"5. The extension of evening schools giving both practical and technical instruction for workers in the trade is demanded by employers in a large proportion of the industries."

The situation in regard to apprenticeship systems is thus described in the machinery and engine construction field:

"In the machine-building trades the survival of the apprenticeship system is perhaps more marked than in any other branch of modern industry. Only a small fraction, however, of the beginners in these industries are now being trained through this method. This small number become the all-round machinists, blacksmiths, molders, patternmakers and boilermakers, and constitute a class of superior workmen from which foremen are gradually drawn.

"The great bulk of the workers under modern conditions are machine tenders or machine hands, running one machine and turning out one kind of work. The proportion of this kind of labor increases in shops producing a highly specialized product and using special machinery. 'Modern automatic labor-saving machinery develops special operators suited for particular machines. Chances for all-round training in modern machine shops are not good under these conditions.' In some cases the product and operations are so specialized that the need for the broadly trained mechanic practically disappears and no attempt is made to maintain an apprenticeship system. 'Manufacturing and assembling under piece work do not constitute a place suitable for the apprenticeship system.' Because of these conditions the largest percentage of all-round machinists are probably to be found at the present time in the job and repair shops.

"Apprentices are commonly taken younger and paid more wages than are beginners in the helper class, and these wages are usually fixed on a definite basis for a term of years. All highly skilled workers are supposed to have passed through an apprenticeship, but as a matter of fact the class is largely recruited from the ablest and brightest of the machine hands or helpers. In some shops beginners start upon the same footing and are passed to high- or low-grade work, according to their ability and their preference.

"The machine business offers such unusual opportunities for advancement that a larger number of boys submit to the low wages and long training periods of the apprentice in this business than in any other. On the other hand, the need for thoroughly trained and intelligent workmen has become so great in the machine trade that employers have made more effort to maintain a system than those in other lines. For these reasons the machine industry offers better opportunities to study both the advantages and defects of the old apprenticeship system, than perhaps any other branch of modern industry."

The chapter devoted to institutions offering courses in industrial training throughout the State is of considerable interest. Each school is treated of in a concise manner as regards founding, scope of its work, number of students, and general results.

Robert M. Van Arsdale

Robert M. Van Arsdale, proprietor of the *American Engineer and Railroad Journal*, died suddenly at his home, in New York City, on November 23.

Born in 1848, Mr. Van Arsdale became connected with trade journalism in his 25th year, and soon became well known in railroad circles. In 1896, after a connection with the *Railroad Gazette* and ownership of the *National Car Builder*, he purchased the *American Engineer and Railroad Journal* from M. N. Forney and combined with it the *National Car Builder*, which became the paper of which he was proprietor at the time of his death.

An illustration of his interest in the progress of the motive-power department on American railways is shown in the elaborate series of tests on locomotive front-end appliances, which were undertaken and most generously provided for by him. These tests were made at the locomotive laboratory at Purdue University under the direction of a committee of the Master Mechanics' Association, which was not then in a financial condition to undertake them itself, and the results obtained were of great importance.

Mr. Van Arsdale was a member of the New York Railroad Club and American Trade Press Association of New York.

Boston Gear Works Burned

The plant of the Boston Gear Works, Norfolk Downs, Quincy, Mass., was partly destroyed by fire on the night of November 27. Newspaper reports had it that the entire plant had been destroyed, but a letter from Mr. Burgess advises that 75 per cent. of the tool equipment was saved and that the plant was partially running two days after the fire. It is stated that the works are now equipped for doing the regular line of work, and that contracts will be filled very closely to dates promised.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make it Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

The New Becker Milling Machine

Those who have watched the development of the vertical milling machine will be interested to note the latest designs of one of the pioneers in this line of tools, and to see that he still adheres to the large fast running belt as a means of driving the spindle. In addition he has developed a friction feed which is both novel and effective, having power enough to carry any cut that the spindle can handle, even without the tension of the springs shown outside the idler pulley.

By making these larger in diameter at their outer end and letting large flanges on the inner ends form friction disks for the feed roller or pulley, a very little mechanism gives a wide range of instantly adjustable feed. The tendency of a belt to run to the largest diameter of the pulley, the pull of the driving belt, which increases with the work done, combined with the proper angle for the idler studs or shafts, gives a feed that is surprisingly simple and efficient. The range is from 0.005 to 0.067 inch per revolution of the cutter.

The sliding head has given way to a heavy quill guided in the frame itself, carrying the spindle to and supporting it in the desired position within a range of 4 inches by hand adjustment. The micrometer stop can be located close to the quill and in the center, which adds to its convenience and accuracy.

The spindle has five speeds through a gear box at the base of the machine, power being transmitted by the large belt from this to the spindle. The spindle speeds range from 80 to 760 revolutions per minute according to the drive from the line shaft, no countershaft being required.

On the front of the table is a reversing mechanism which acts continuously as a planer, traversing the table as long as desired, or can be set to let the work run under the cutter and back to the stopping point and then stop, or to stop after a single passage of the work. This feature will often be found very desirable.

The table is 10½x32½ inches, is very heavy, and is supported by a long saddle on a knee of substantial design. Three curtains of heavy but flexible material, mounted on spring rollers, protect the ways from chips and dirt. The automatic longitudinal feed is 24 inches and the hand cross-feed 14 inches.

The knee is held to the column by a special form of shoe which does away with the usual gib and makes a very substantial bearing which should reduce the wear to a minimum. It also allows the locking of the knee solidly when desired.

The rotary attachment is driven through a pair of spur gears at the back of the small gear box which is used to multiply

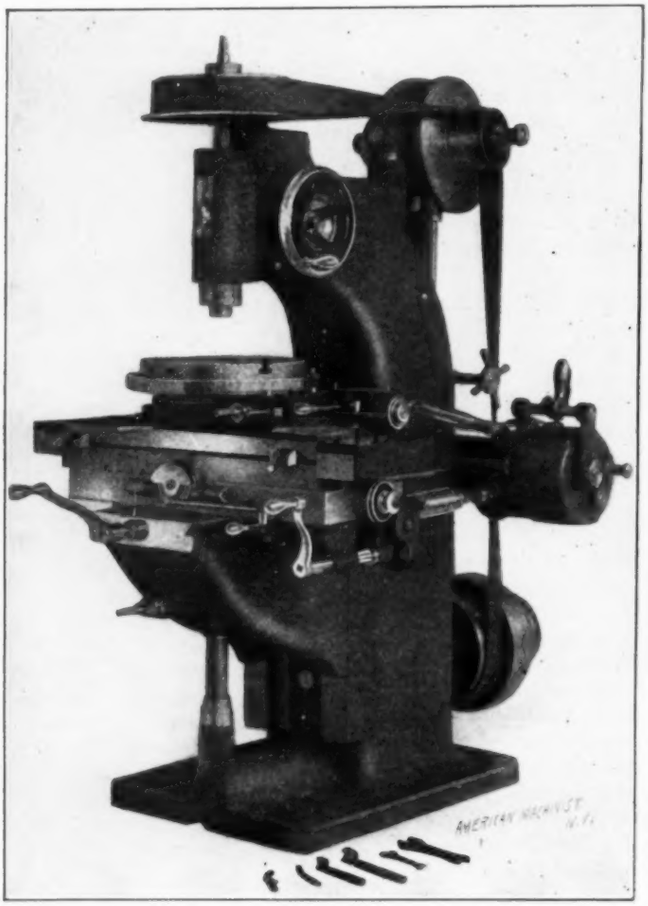


FIG. 1. THE NEW BECKER VERTICAL MODEL A MILLER

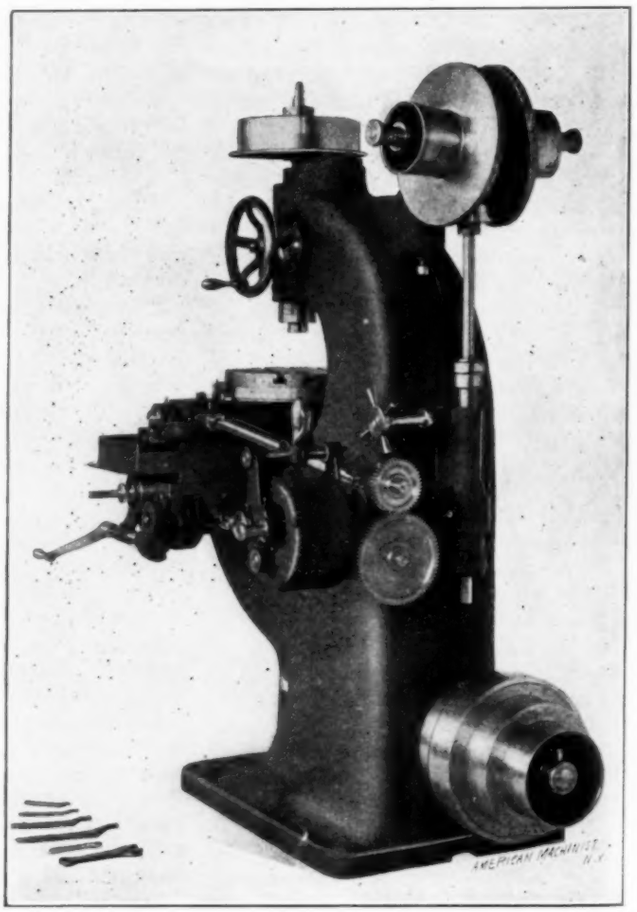


FIG. 2. REAR VIEW SHOWING GUARD REMOVED FROM ROTARY TABLE FEED

the range of feeds obtained from the disks. These gears can be readily removed or replaced at any time. This is known as the class A machine, of the Becker Milling Machine Company, Hyde Park, Mass.

Motor Driven Precision Lathe Mounted on Cabinet

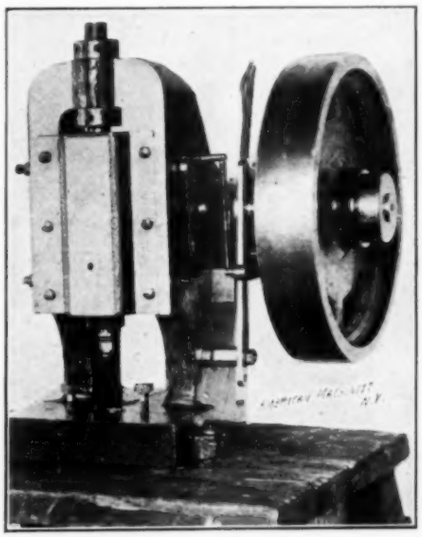
The halftone illustrates a Rivett precision lathe mounted on a neat cabinet and equipped with motor drive so that the apparatus is complete in itself and therefore well adapted for use in the laboratory or private workshop as well as in the tool room. The location of the motor will be obvious upon inspection of the halftone, the driving pulley being shown near the bottom of the cabinet, with the belt leading up along the left-hand side to the countershaft on the cabinet top. With this motor and countershaft arrangement, all speed variations from 100 to 1500 revolutions per minutes, necessary for the operations of grinding, milling, etc., are obtainable. The drive from the cone on the countershaft to the corresponding cone on the head is shown

A MOTOR-DRIVEN PRECISION LATHE MOUNTED ON A CABINET

clearly, as is also the method of belting to the drum at the top, which drives the milling attachment, grinding spindle, etc. The view shown illustrates the spiral-milling attachment secured at the end of the bed. This consists of mechanism operated from the driving gear on the lead screw and connected by a shaft and universal joints with the worm gearing which operates the head. Thus the work to be milled spirally and the carriage carrying the milling cutter are geared together to give the required lead. The cabinet upon which the lathe is mounted is of quartered oak, nicely finished, and so proportioned as to take as little space as possible yet provide sufficient surface for the lathe and all of its attachments. The maker is the Rivett Lathe Manufacturing Company, Brighton, Boston, Mass.

Bench Power Press

This bench press has the gate actuated by means of a knuckle-joint mechanism



KNUCKLE-JOINT BENCH POWER PRESS

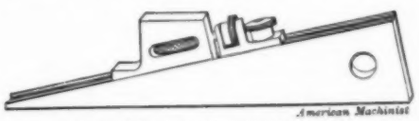
similar to that used on embossing and coining presses, and is adapted for punching, light stamping, embossing and other sheet-metal work. It is provided with a one-revolution clutch mechanism by which only one stroke of the gate can be made by each depression of the treadle, and can be run at mediumly high speed.

With this type of press an equal pressure is always exerted, thus producing uniform work. The stroke of gate can be varied up to 2¼ inches, has a bed surface of 12 feet by 7½ inches, and the complete machine weighs 500 pounds.

The machine is the product of the Atlas Machine Company, Waterbury, Conn.

Adjustable Sizing Block

The use of such a tool as this grows on a man after he gets accustomed to it. For



AN ADJUSTABLE SIZING BLOCK

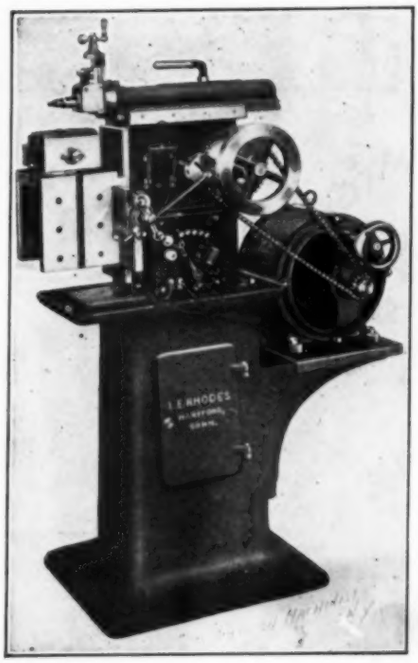
squaring up on lathes where inside measurements must be taken in narrow places, it is particularly useful. In planing or milling work it is also useful in setting work or tools, such as placing straddle mills the right distance apart.

The top surface of the sliding block or step is ground parallel with the bottom of the base. This can be moved for final adjustment, by the small screw above it and afterward clamped to the base by the locking screw in the block. It will also be noted that there is a lower step to the block, also parallel to the base. This gives a minimum measurement of 3/16 inch while the top of the large block gives 1½ inches as a maximum, although the total length is only 5¼ inches.

The tool is only 7/16 inch thick and can be conveniently carried when necessary or hung up by the hole in the end. The adjusting screws are all below the top surface of the block, so are not in the way in the least. There are no graduations, being set to size by micrometer or other standard gages. The tool is made by the Tip Top Tool Company, 78 Vernon street, Worcester, Mass.

A Small Motor Driven Shaper

The illustration shows a small shaper built by L. E. Rhodes, Hartford, Conn.,



SMALL MOTOR-DRIVEN SHAPER

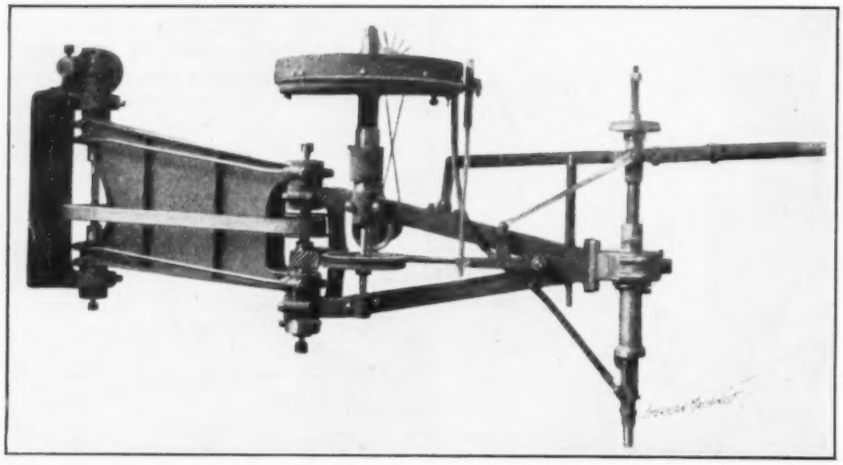
and equipped with a motor drive for manual-training schools' and model makers' use.

The shaper is driven by a crank, and has 7⅜-inch stroke, while the table moves 7 inches vertically and 9 inches horizontally. It is geared 6 to 1 between the balance wheel and the ram and 3 to 1 from the sprocket to the motor. The Lincoln motor, of ⅜ horsepower, also has a 6 to 1 range so that almost any desired speed can be obtained. The finest feed is 0.0025 inch, the head is graduated in degrees and has a positive clamping device for fastening it to the ram.

The drive is by a Whitney silent chain and the arrangement of switch and rheostat places everything under control of the operator without leaving his position from the front of the machine. For experimental work where the usual methods of driving are not available or are undesirable, this presents a very attractive outfit.

Magazine Power Screwdriver

The illustration shows a convenient form of power screw driver made by the Reynolds Machine Company, Moline, Ill. This is fastened to the wall or to a post and the double swinging arm gives easy access to any point within its range. As can be seen, spiral and worm gears are largely used for the driving mechanism so as to secure universal movement in various directions. There is a magazine rotated from below and having a distributing wheel for insuring the constant delivery of screws to the screwdriver. The general principles of the machine are similar to those used in their other types.



MAGAZINE POWER SCREW DRIVER

Interesting Chuck Details

The chucks illustrated herewith are made by the D. E. Whiton Machine Company, New London, Conn., and contain several novel features. The chuck at the left in Fig. 1 is a combination two- and three-jawed scroll chuck, or all four jaws can be used together if desired on any special work. Used as a two-jawed chuck, jaws are placed in slots *A* and *A* while for regular three-jawed work *A B C* are used.

These jaws have a very interesting adjustment to allow any individual jaw to be moved either in or out without disturbing its relation to the scroll and allowing all jaws to be moved together, in this new relation. The jaw base *C* does not mesh directly with the scroll, but carries the toothed block *D*, which engages the scroll and is connected with the jaw base by the screw *G*, shown in Fig. 3. This allows the jaw base to be adjusted more than a thread of the scroll, which is all that is necessary, as further adjustment can be secured by moving the whole thing one or more as desired.

Fig. 3 shows the construction of the jaw with the two guiding ways which support the jaw base at each end. The adjustable block *D* secures a full bearing on the lower guide leaving the upper guides continuous on the jaw base itself. Fig. 2 shows the chuck in detail, including the wrench with detachable crank handle.

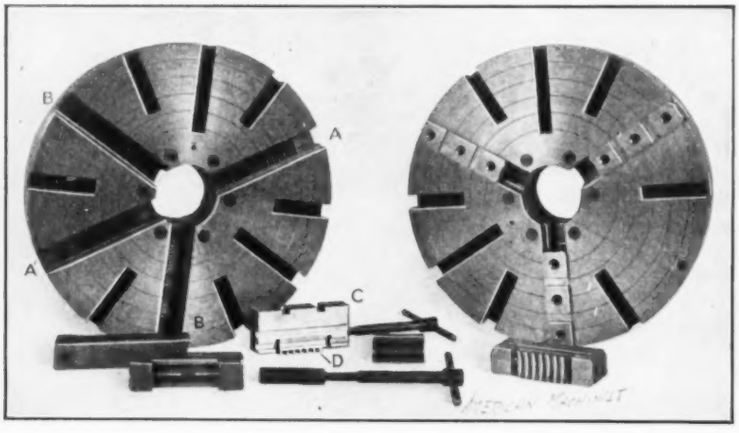


FIG. 1. COMBINATION 2 AND 3 JAW CHUCK

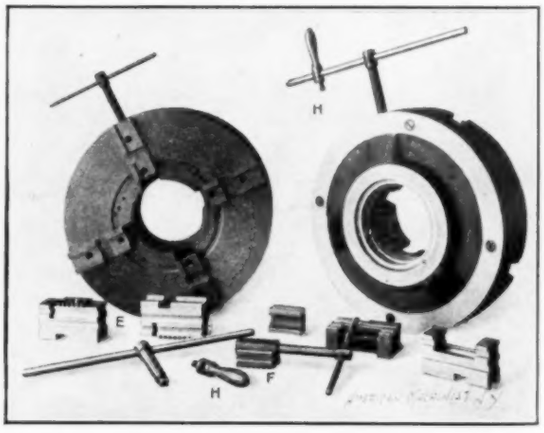


FIG. 2. DETAILS OF CHUCK JAWS

The Universal Collet

The use of a spring collet or draw-in chuck has many advantages in some classes of work, but as usually made it is limited in range. In the device illustrated herewith the idea has been to retain the advantages of the collet and increase its range by introducing adjustable jaws in a jaw head, these jaws being adjusted radially by cams, as shown in the end view, being tightened by drawing in the entire jaw head in the usual way.

Referring to the illustration, we have the faceplate *A*, a collet hood *B*, the jaw guide *C* having the cam slot before referred to, and the keys *D* which allow the jaw head to be moved in and out, but prevent its turning and insure a positive drive to the work. The jaw head is drawn in by the tube running through the spindle as is usual, and the spring shown around the draw-in head forces the jaw

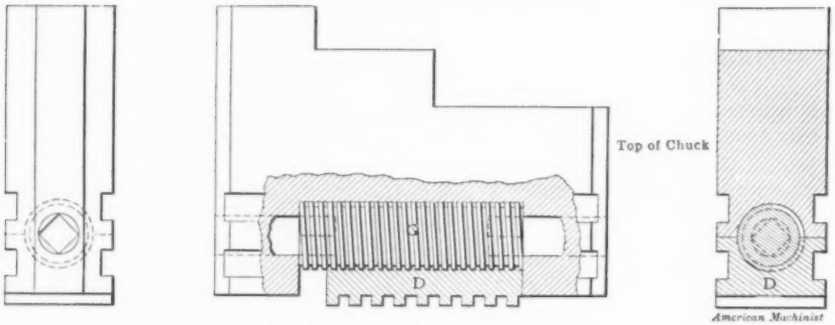
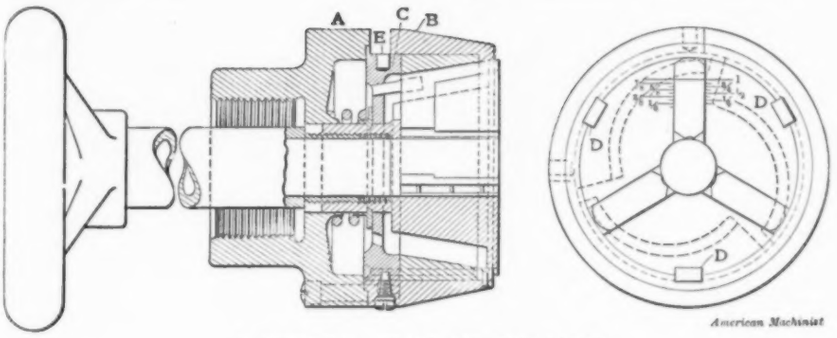


FIG. 3. HOW THE JAW IS MADE



A UNIVERSAL COLLET FOR THE LATHE

head out and releases the work as soon as the draw-in tube is loosened.

The jaws are easily adjusted for different sizes by a pin wrench inserted at *E*. The jaws are furnished either hard or soft as desired, and the collets are made either "draw" or "push" according to the machine on which they are to be used. The makers are the Cleveland Collet and Machine Company, Richardson building, Cleveland, Ohio.

Some Interesting Drill Combinations

The sensitive drills of the Taylor & Fenn Company, Hartford, Conn., are built on the unit system so that heads of any kind can be assembled on one base or any number of heads of the same kind, arranged and spaced as desired.

A combination of hand-fed spindles is shown in Fig. 1, four heads being grouped at any desired spacing and all fed by either of the two handles shown. This provides for simultaneous drilling of four holes at once without raising the table and work up against the drills. Clamping handles avoid the use of wrenches.

Fig. 2 shows a four-spindle combination which is used in some instances and which can be varied to suit requirements. Beginning at the left we have a geared feed capable of driving a ¾-inch drill and next to it a hand-feed spindle of the same capacity. The third is a very high-speed head for small drills and has an extremely sensitive feed, while last in line is the same head as the second, except that it

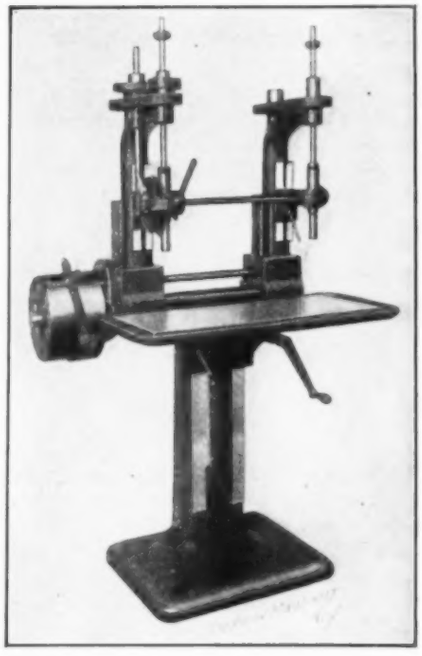


FIG. 3. ONE POWER FEED FOR TWO SPINDLES

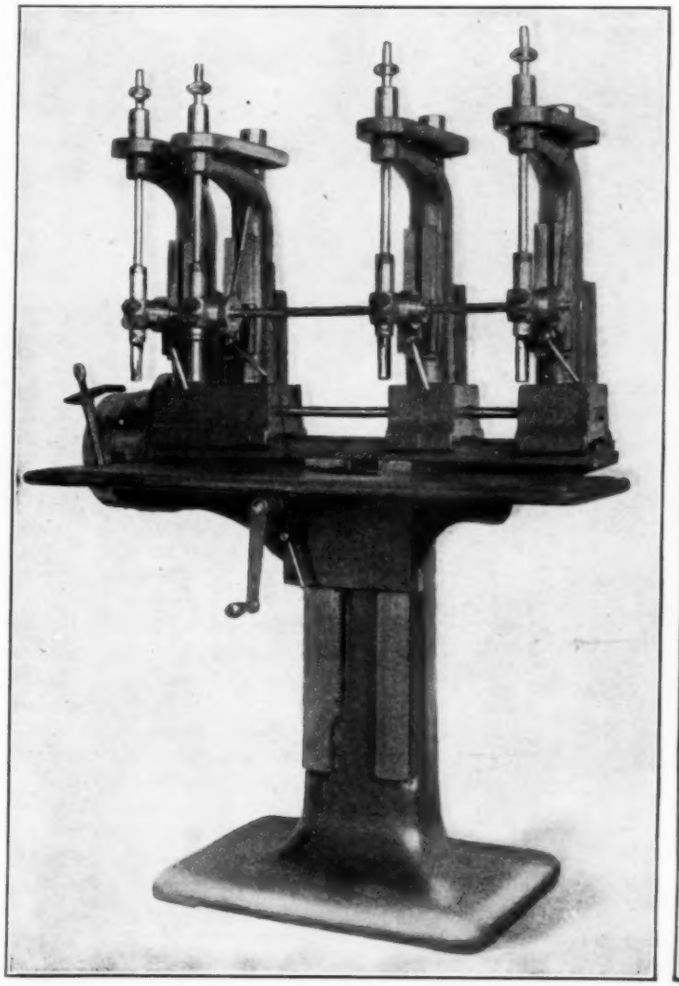


FIG. 1. COMBINATION OF HAND-FED SPINDLES

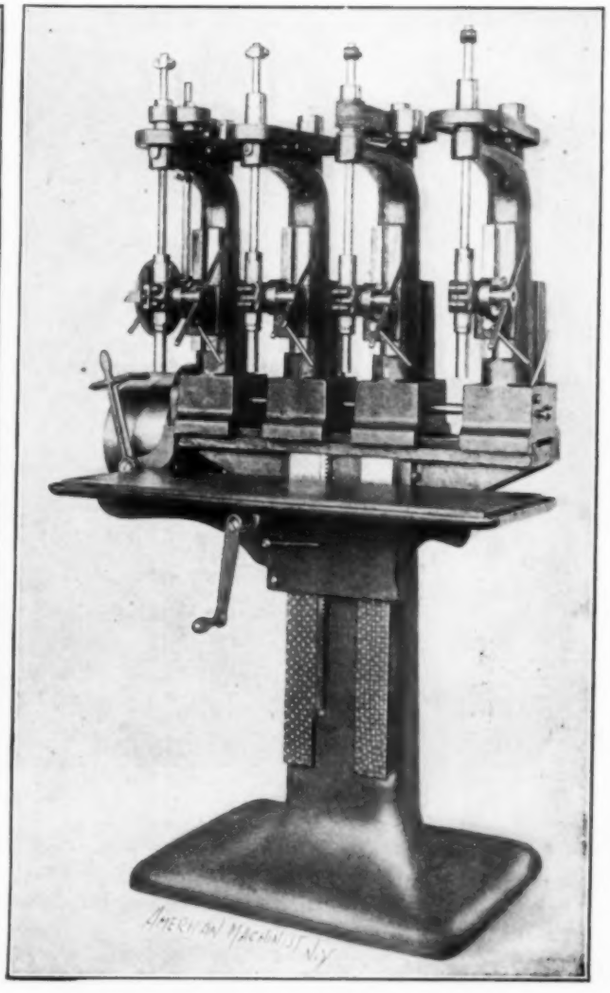


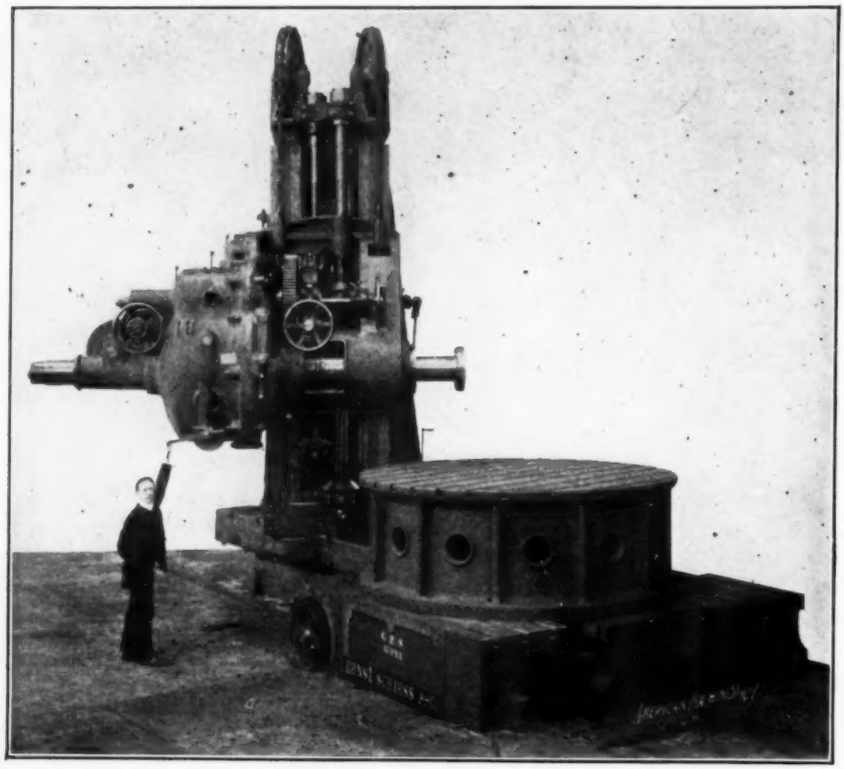
FIG. 2. FOUR KINDS OF HEADS ON ONE BASE

is equipped with one of the new tapping attachments which allows the use of any kind of chuck and places the reverse at the instant control of the operator.

The way in which one power feed is made to serve for two spindles is shown in Fig. 3, a horizontal shaft transmitting the power from one to the other. This can be applied to any number of spindles until the torsion of the shaft begins to introduce serious variations in the distance fed by the various spindles.

A Large Special Milling Machine

This has been designed especially for work on electrical machinery for milling grooves in cylindrical castings. The column has a cross movement of 16 inches and can also rotate through an arc of 60 degrees on the bed. The saddle or work table has hand, automatic and quick power traverse on the square ways shown in the center, while the spindle is driven by an electric motor of 40 horsepower through gearing which gives it a range of suitably proportioned speeds, varying from 2.65 to 53 revolutions per minute. The spindle is of forged steel, 10 inches in diameter and has both hand and power traverse.



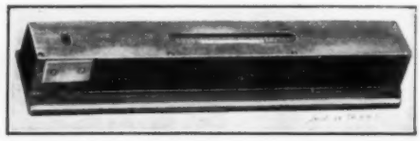
LARGE SPECIAL MILLING MACHINE

Some idea of the large proportions of the machine can be seen by comparing it with the man, but it should be noted that when in operation the machine is set on a foundation, bringing the table but little above the floor, so that the operating levers are within easy reach.

This is built by Ernst Schiess, Dusseldorf, Germany.

A Precision Spirit Level

The illustration shows a sensitive spirit level for the use of machinists which is being put on the market under the name of the "Sterling Machinists' Precision Level," by the Iszard-Warren Company, Inc., manufacturers of surveying instruments, 136 North Twelfth street, Philadelphia, Penn.

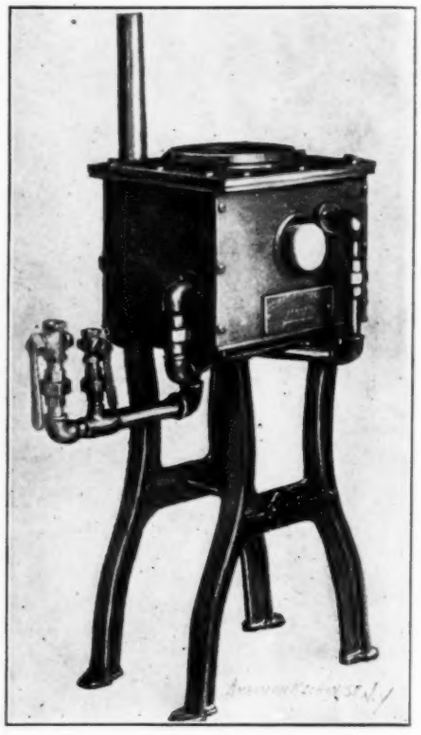


A PRECISION LEVEL

These levels are built in six sizes from 2 to 24 inches in length, inclusive. The body of the level is of cast iron and the top of brass. A short, accurate cross-level is mounted at one end. The main bulb is graduated to tenths of an inch, and is so accurately ground and adjusted that an elevation of 0.001 inch at one end of the level will cause the bubble to move one division on the glass.

Hardening Furnace for Lead and Cyanide Baths

The illustration shows the latest product of the U. S. Gas Furnace Company, Providence, R. I., in the line of lead and cyanide hardening furnaces. One of the smaller sizes is shown, mounted at a convenient hight and equipped with two burners, both being supplied by the main inlet pipe with its controlling valves for gas and air. When used for cyanide, a hood is fitted to carry the fumes away. This is especially recommended for hardening fine cutting tools, springs, etc.



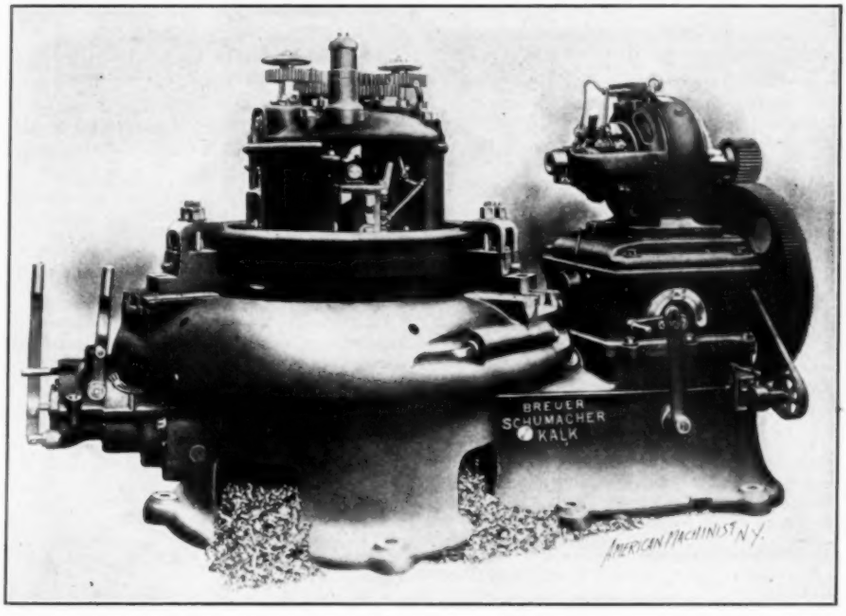
HARDENING FURNACE FOR LEAD AND CYANIDE BATHS

A Novel Horizontal Tire-boring Mill

This horizontal tire-boring mill contains radically new features, and differs from all other machines for similar work, the necessary tool holders being arranged inside the work to be bored in such a way that it is not necessary to remove the tool holders for adjusting the tools. They are supported in a way to allow the taking of a heavy cut without chattering, and are fed down through the work, which is revolved on the annular table outside of the tools by spur gearing.

The tool-holding mechanism is automatically disconnected when the proper size has been reached, without the necessity of measurements on the part of the

operator, so that sets of tires can be bored to the same diameter. It consists of a hollow cast base, on the top circular faceplate of which are three clamps which are movable radially. The tire is held down on the faceplate by the clamps; the faceplate is provided with a centering guide formed of an adjustable conical box which surrounds a central pivot on the base plate. The tool-holder support is strongly fitted on this central pivot; the support is U-shaped, closed at top by a cover, the two tool holders being diametrically opposite each other. One of the holders carries two cutting tools for cutting the retaining-ring groove and the lip, the other also carrying two tools, one for roughing and one for finishing cuts. The travel of one tool holder is independent of the other; the travel being effected by the gearing shown. The machine is thrown out of action automatically by means of adjustable stops.



A NOVEL TIRE-BORING MACHINE

It can be driven either from the line shafting, or direct by an electric motor mounted on the frame. A mechanically driven pump supplies the lubricant for cooling. The faceplate and baseplate are so built that the chips and water collect in a trough cut round the base plate whence they can easily be removed.

This interesting machine is built by Breuer, Schumacher & Co., Ltd., Kalk, near Cologne, Germany, for tires from 30 to 42 inches inside diameter. As an example of its rapid work, the builders cite the boring of a tire 34 inches inside diameter in 10 minutes, not counting the setting or taking off the work.

From a consular report it is noted that an Italian engineer has invented a reversible turbine engine for which there are claimed several important advantages.

Unnecessary Work—Shrink Fits—Surfaces for Bearing—Lubrication

By John R. Godfrey

One of your editorials touched very pertinently on "Unnecessary Accuracy," and struck a responsive chord in the breast of many a machinist, foreman and superintendent—all who really appreciate what it means. But there is another question which is also important, perhaps of equal importance—the question of unnecessary work.

I was in a shop not long ago where they were doing some remarkably good milling on the frame doors that cover the tool shelves in the base of this particular machine. They were held in a good fixture and a large milling cutter on a vertical-spindle machine was sweeping off the metal at a tremendous rate. The cut varied from ⅛ inch up to ¾ inch in spots but the cutter ploughed through it in great shape, finishing a door in about 5 or 6 minutes.

It was remarkable milling but entirely unnecessary and should not have been done. The doors can be cast with sufficient accuracy and should require no finish.

As somebody or other said or ought to have said, of a brilliant charge in solid ranks against cannon fire—"It is magnificent but it is not war." So this milling "is magnificent but it is not business." And some shops are waking up to the fact that good castings pay, though only a few have really learned the lesson well enough to really take it to heart.

Another instance was the planing of some lathe beds several years ago where the planer was giving all sorts of exhibitions of getting off metal by the cart load, taking cuts that were from ⅛ to ⅞ inch deep. Both tool and planer stood up at a good cutting speed, but it wasn't business. Something was wrong with either the castings or the metal—probably both as it happened. For I saw some of these lathes a few months ago and the ways have worn down more than the service would warrant and the whole surface looks pretty porous for this kind of a casting.

Analyzing the question it probably comes both to the difficulty of obtaining lathe-bed castings straight enough to lie still over night, the putting on of enough metal to allow for this and still clean up, and the discovery that a soft iron must be used in order to machine the beds with their uneven depths of cut, in a reasonable time.

But the question of unnecessary work will bear careful study and I believe there are few shops where this could not be reduced by good castings.

Shrink Fits with Steam and Ice Water

I ran across a good example of shrink fits the other day which had an unusual flavor. In the case of locomotive tires or similar work we are accustomed to heating the outer member to good heat, but in this case the difference in temperatures was surprisingly small.

The outer member was a large cast-steel cylinder with a steam jacket which had to be lined with a cast-iron sleeve to run the piston in. The bore was perhaps 60 inches and two liners had to be used, one from each end. These had to meet in the center and also fit at the flanged ends against the ends of the cylinder. This took some nice figuring and experimenting—especially the latter—but the results were all that could be asked. The really novel part was the shrinking itself.

Instead of heating the cylinder with a coal fire or a gas flame, steam is turned in at a pressure of perhaps 100 pounds to the square inch, which gives a temperature of 337.6 degrees Fahrenheit. The bushing is cooled in ice water and after being shoved into place, the cylinder jacket is also treated to the same concoction and the contraction grips the bushing so tightly that none have ever come loose.

Lubrication

Speaking of lubrication recalls the extremely woozy ideas too many of us have as to just what lubrication is. We talk about viscosity, often without realizing that it is a quality we could well dispense with if it wasn't for the need of some "body" in the oil to keep the bearing surfaces apart.

I remember in the earlier days of graphite as a lubricant, a mixture of wood pulp and graphite was used quite extensively for bearings of various kinds, being molded into the proper shape and run with little or no oil.

A striking example was a large rattail

file with a pulley in the center and running in a graphite bearing at each end. It, of course, cut out enough graphite to fill the teeth solid full, making it a shaft of graphite so far as the bearing surface was concerned, and it then ran as smoothly as possible where the shaft is appreciably smaller than the hole. This shows in an exaggerated form what takes place in any bearing. The lubricant fills in the hollows and is carried around with the shaft as with the graphite in the file teeth. A lubricant which can fill in these hollows and round them out, yet not retard the motion of the shaft by its viscosity or stickiness seems to be what is needed.

An oil expert tells of a large mill where the load was almost up to the maximum for the engine. A new oil was tried and the stickiness, the tenacity with which the particles hung together, was enough to stall the engine. Sounds a bit fishy, of course, but it was the last straw that broke the camel's back, so why not the last drop of oil? It goes to show that the oil we pour into a bearing may make it run harder than before; no one would expect to have a shaft run easily with honey or molasses in the bearing, and yet some oils can show a close second so far as stickiness is concerned.

Our graphite friends contend that the only real, 18-carat lubrication is to use graphite to fill the hollows in the shaft and its bearing and so present a solid, nonviscous surface that couldn't stick if it wanted to.

Some even go so far as to predict that the use of graphite, or some solid lubricant, will eventually replace oil entirely, and that it will be fed to the bearings by some medium such as water, to be deposited there while the water passes on, carrying away any heat and having performed its mission.

Speed of "La Demoiselle"—Erratum

A correspondent sends us the following letter which surely shows that there is "one on us." Our correspondent confused kilometers and meters, and the editor did the same:

The description of Santos Dumont's aëroplane, on page 793, reminds me of the small boy about to jump over a 12-inch gutter. He wastes enough energy swinging his arms and bending his legs to take him around the block and then springs over the 1-foot chasm which he could easily have stepped across.

The Aëro club's official record states "that the machine rose after traveling 70 kilometers in 6⅕ seconds, etc."

Seventy kilometers is about 43 miles. Forty-three miles in 6⅕ seconds is sure going some.

The machine "actually rose after going only 40 kilometers (24 miles), but it touched the earth again and required 70 kilometers to get fully under way." Seventy kilometers is about 43 miles. All this preliminary spurt was to go about 11 miles. Something like going to Hoboken from New York by way of Philadelphia.

On solid ground the machine made a speed of 420 miles a minute but with only air resistance the machine could not make more than 2/5 mile a minute. This looks like the greater the resistance the greater the speed. We'll soon have rock drills carrying passengers.

RAILROADER.

Forthcoming Meetings

American Society of Mechanical Engineers, annual meeting, New York City, December 7-10. Calvin W. Rice, secretary, United Engineering building, New York City.

American Society of Agricultural Engineers, third annual meeting, December 28-29, 1909, Ames, Ohio. F. W. Chase, secretary, University of Nebraska, Lincoln, Neb.

Business Items

It has been reported that Chas. G. Smith Company, Pittsburg, Penn., intended to retire from the machine-tool business. This is erroneous.

The engine shop of Kumberger & Vreeland, 33 Sullivan street, New York city, has closed out, its machine shop equipment being purchased by J. J. McCabe, 30 Church street, New York City.

The Knecht Planer Company, Cincinnati, Ohio, have recently sold their drill business to the Crane Machine Tool Company, of that city, and will now make their newly developed high-speed planer their exclusive product.

Business Opportunities

C. E. Lund, Wishkah, Wash., will erect a boat factory.

J. Lockington, Aberdeen, S. D., will enlarge its packing house.

The Brown Cotton Mill at Tiverton, R. I., is building an addition.

The Erie (Penn.) Car Works is building an addition to its plant.

The Minnesota Fibre Company, Lakefield, Minn., will erect a tow mill.

The Findlay (Ohio) Ditcher Machine Company is enlarging its plant.

The Crocker Chair Company, Sheboygan, Wis., will enlarge its plant.

The Burlington Railroad will erect a machine shop at Havelock, Neb.

The Milwaukee (Wis.) Vinegar Company will erect a four-story addition.

American Canning Company, St. Paul, Minn., is enlarging its plant.

The Connellsville (Penn.) Iron Works is preparing to build an addition.

The Manitowoc (Wis.) Electric Company will double the size of its plant.

The Northern Pacific Railroad will erect a $125,000 foundry at Brainerd, Minn.

The Conger Safe Company, Oklahoma City, Okla., will erect a new $75,000 plant.

Ocean Beach Packing Company's clam cannery at Westport, Wash., was burned.

O. H. Hahn, 3010 McKinley Boulevard, Milwaukee, Wis., will erect a garage.

The Twin City Mission Furniture Company, St. Paul, Minn., will erect a new plant.

The sawmill of the Red River Lumber Company, at Akely, Minn., was burned.

The Detroit (Mich.) Gear Grinding Company is erecting a new factory building.

Keufield & Lamoreaux, Washburn, Wis., contemplate installing a box-printing plant.

The Alton (Ill.) Shovel Company will rebuild its foundry and shops recently burned.

Hugo Fast will erect a garage on Muskego avenue, near Burnham street, Milwaukee, Wis.

C. A. Meyer, of Clarkfield, Minn., will install an electric-light plant at Hettinger, N. D.

Dresen Brothers, carpenters, Sauk City, Wis., will erect an addition to its factory.

The council at Aurora, Minn., voted to purchase a new boiler for its waterworks plant.

The Minneapolis & St. Louis Railroad will enlarge its roundhouse at Watertown, S. D.

The Lett Box and Cooperage Company, St. Joseph, Mo., will erect a plant in Oklahoma City.

The Fergus Packing Company, Fergus Falls, Minn., will install a refrigerating plant.

The Iowa Tile Ditching Machine Company, of Stockport, Ia., will locate at Mt. Pleasant, Iowa.

Mr. Farrar, of Columbia Falls, Mont., has applied for a franchise for an electric-light plant.

The National Car Wheel Company, Cleveland, Ohio, will double the capacity of its plant.

Chas. Bond, Des Moines, Iowa, will erect a laundry building at Sixth and Chestnut streets.

The Kalt-Zimmer Shoe Company, Milwaukee, Wis., will erect a new $60,000 factory.

The Malleable and Grey Iron Company, Layton Park, Milwaukee, Wis., will erect an addition.

The Brinkerhoff Stamp Vender Manufacturing Company, Clinton, Iowa, will remodel its plant.

The Fostoria (Ohio) Glass Specialty Company is to erect another factory at a cost of $60,000.

The Minnesota Mining Manufacturing Company will erect a sandpaper factory at St. Paul, Minn.

The Jos. Obenberger & Sons Company, Milwaukee, Wis., will build a new machine and forge shop.

The Wissmath Packing Company, Fort Madison, Iowa, is making extensive improvements.

The I. Stephenson Lumber Company, Menominee, Mich., will build a new mill at Wells, Mich.

The Western Sugar Company, Hamilton, Mont., is considering the erection of a beet-sugar factory.

The Consumers Ice Company, Sioux City, Iowa, will erect a plant of about 150 tons daily capacity.

Cook & Kettering, Geneseo, Ill., manufacturers of gasolene engines, are erecting a two-story addition.

The Titanium Alloys Manufacturing Company, Niagara Falls, N. Y., will erect a large addition to its plant.

The Iowa Central Railroad will build another addition to its machine shops at Marshalltown, Iowa.

The Owens Bottle Machine Company has awarded contract for the erection of a plant at Fairmont, W. Va.

The Buffalo (N. Y.) Foundry and Machine Company is having plans prepared for a new $75,000 foundry.

The Pitt Carriage Company, Des Moines, Iowa, will build an addition for its auto garage and repair shop.

The Auto Crank Shaft Company, 192 Piquette avenue, Detroit, Mich., is erecting a two-story factory building.

The Fort Wayne (Ind.) and Wabash Valley Traction Company will, it is said, establish shops at Logansport, Ind.

The Findlay (Ohio) Carriage Company is enlarging its plant. Will manufacture automobiles. Need some tools.

The Electric Weldings Products Company, Cleveland, Ohio, has obtained a permit to erect a new $30,000 factory.

The Treport Auto Gasolene Engine Company, of Rochester, N. Y., will erect a new plant at Columbia City, Ind.

The Pittsburg Valve and Fittings Company, Barberton, Ohio, is erecting an addition to its malleable iron department.

The Great Northern Railroad will make considerable improvements at its shops in Waite Park, St. Cloud, Minn.

The Security Stove and Manufacturing Company, Kansas City, Mo., is erecting an addition, to cost about $12,000.

The Missouri, Kansas & Texas Railroad has applied for a permit for the erection of a roundhouse at St. Louis, Mo.

The Eaton (Ohio) Lumber Company will erect a building to be equipped with woodworking machinery for mill work.

The Chicago, Milwaukee & St. Paul Railroad will build a plant at Tomah, Wis., for the manufacture of railroad bicycles.

The Hennepin Bridge Company, of Minneapolis, Minn., will establish a plant in Fargo, N. D., for the manufacture of culverts.

The plant of Chas. A. Krause Milling Company, Milwaukee, Wis., was destroyed by fire. Loss, $200,000. Will rebuild in spring.

The Berlin Machine Works, Beloit, Wis., will build a new plant to cost about $500,000, for the manufacture of sawing machinery.

The Erie (Penn.) Engine Works has purchased site for enlargement of its plant. New foundry building will be erected at once.

The Thompson & Norris Company, Brooklyn, N. Y., manufacturing paper, bottle packing, etc., will erect a twelve-story factory.

The Kiel Furniture Company, Milwaukee, Wis., has purchased the plant of B. A. Kipp Company and will erect another four-story building.

The National Iron Works, Toronto, Ont., has obtained a permit for the erection of first building for a new plant. This is to be a foundry.

The Government sawmill at Neopit, Wis., is to install additional equipment. Shingle mill will also be erected. A. M. Riley, superintendent.

The Nelson Trading Company, Orange, N. J., is in the market for machinery for the manufacture of cutlery. Address is Post Office Box 933.

The Reed & Prince Manufacturing Company, Worcester, Mass., making machine screws, wood screws, etc., will build a two-story addition.

The United Engineering and Foundry Company (Lloyd Booth Department), Youngstown, Ohio, has purchased site on which a new shop will be erected.

Gehrlic & Shumiata Tile Company, Wapakoneta, Ohio, is contemplating installing a new 100-horsepower boiler and 50- or 60-horsepower engine.

It is reported that the Hays Manufacturing Company, Erie, Penn., manufacturing waterworks supplies, will build a factory in Montreal, Canada.

The W. F. Norman Sheet Metal Manufacturing Company, Nevada, Mo., is rebuilding a portion of its plant recently burned. Will need new machinery.

It is reported the Lozier Motor Company will erect an automobile factory in Detroit, Mich., to cost $800,000. Present factory is in Plattsburg, N. Y.

C. F. Splitdorf, New York, manufacturing electrical specialties, is erecting a branch plant at One Hundred and Thirty-Eighth street and Mott avenue.

The Walworth Run Foundry Company, Cleveland, Ohio, will erect a new molding room. Blower, molding machines and other foundry equipment will be purchased.

The Seibold-Speer Machine Company, Fort Worth, Texas, recently incorporated, will erect a plant. Bids for machinery will be opened January 1. E. Seibold, president.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., December 14, for furnishing carbon tool steel during the year ending December 31, 1910, as per Circular No. 544.

The General Motor Company has completed plans for the erection of a $2,500,000 automobile plant in Detroit, Mich. This company controls the Cadillac factory in Detroit, the Oldsmobile in Lansing and a number of others.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., December 20, for steel and manganese-steel castings, wire rope, chain, saws, pipe cutters, screw clamps, steam cocks, etc., as per Circular No. 545.

Chas. Prochnow, chief engineer, Post Office Box 276, Flagstaff, Ariz., would like catalogs of power equipment for a sawmill of 100,000 feet daily capacity to be built in the spring, also catalogs of machine shop equipment and iron-roof construction for power houses.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: December 14—Emery, emery cloth, grindstones, 4-ton hydraulic jacks (schedule 2005), direct-current motor (schedule 2001), 4-inch galvanized pipe, copper tubing (schedule 2007), 3-inch wrought-iron pipe (schedule 2004), brass tubing (schedule 2001), engine lathes (schedule 1999); December 28—Files, planes (schedule 2015), screw-cutting lathe, ice machine (schedule 2000).

New Catalogs

Wells Bros. Company, Greenfield, Mass. Catalog No. 25, describing limit gages for A. S. M. E. standard of machine screws. Illustrated, 8 pages, 5x7½ inches.

Sprague Electric Company, 527 West Thirty-fourth street, New York. Pamphlet, Form No. 233, describing electric hoists, shovels, winches. Illustrated, 24 pages, 4x9 inches.

Crocker-Wheeler Company, Ampere, N. J. Bulletin No. 116, illustrating and describing motor-generator sets. 12 pages, 7x10 inches. Bulletin No. 117 showing motor drive in the laundry. 16 pages, 7x10 inches. Bulletin No. 118, illustrating and describing Form L direct-current machines, small powers. 16 pages, 7x10 inches.

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Position as superintendent or chief draftsman; now engaged; 10 years' practical and executive experience in both shop and drawing office; modern methods for rapid production of interchangeable parts. Box 965, AMERICAN MACHINIST.

ILLINOIS

Foreman (36), successful record, especially efficient on marine engine work of all description, wants to make a change. Box 983, AMERICAN MACHINIST.

Mechanical engineer having eight years' practical workshop experience and nine years drafting and designing machinery and special tools, wants position as assistant superintendent in machinery manufacturing plant. Box 948, AMERICAN MACHINIST.

Wanted—Position as superintendent or assistant thoroughly conversant with piece work and up-to-date methods of manufacture of interchangeable work; have had 18 years' of general shop practice; at present employed in a responsible position with a large manufacturing company. Box 964, AM. MA.

MASSACHUSETTS

Experienced toolmaker and draftsman having had extended experience in charge of men and work; desires responsible position. Box 966, AMERICAN MACHINIST.

NEW JERSEY

Technical graduate, with five years' experience on general machinery, printing press and automatic machine design. Box 957, AM. MA.

Salesman—Machine tool salesman as sales manager, having 15 years' experience, both in the manufacture and selling of machine tools; competent judge of condition and value of second-hand, and familiar with all makes in the United States; can give best of reference. Box 790, AMERICAN MACHINIST.

NEW YORK

Position in New York City wanted by mechanical-electrical engineer with fifteen years' experience; graduate Massachusetts Institute Technology; now employed. Box 984, AM. M.

Practical mechanical engineer, expert in designing, manufacturing and erecting, with energy, quick comprehension and accustomed to heavy responsibilities, wants position. Box 979, AMERICAN MACHINIST.

Foreman of machine shop or manufacturing; 20 years' practical machinist; technical education, modern methods and system; expert on electrical apparatus or experimental work; New York city preferred. Box 972, AMERICAN MACHINIST.

Superintendent or general foreman familiar with modern shop practice and equipment and the manufacture of interchangeable work; pattern, foundry, die, tool and drop forging and drafting room experience; American, 37. Box 932, AMERICAN MACHINIST.

Electrical engineer with highest references, wishes to form connection with good concern,

preferably in or near New York; three years' experience in Mexico, five years in Chile; speaks Spanish and German fluently; has had wide experience, both in selling and constructing electrical, steam and hydraulic machinery; open for immediate engagement. Address "H. K. W.," AMERICAN MACHINIST.

OHIO

Experienced piece work and rate setter to take charge of machine shop. Box 943, AM M.

Machine designer and mechanical draftsman with shop experience, 29, college graduate, desires change. Box 982, AMER. MACH.

Position of responsibility by engineer, experienced in designing, building, demonstrating, mill construction and equipment; fourteen years' practical experience; technical education. Box 981, AMERICAN MACHINIST.

PENNSYLVANIA

Wanted—Position as assistant manager by competent works office manager; best of references. Box 952, AMERICAN MACHINIST.

Works manager, at present engaged, desires change; 22 years' machine shop and foundry experience; successful executive, inventive, machine designer, duplicate manufacturer; can reduce costs and increase production. Write for full particulars, Box 980, AMER. MACH.

Desire correspondence with firm needing representative in territory northeastern Pennsylvania, with Wilkes-Barre as center of operations; first-class mechanic, good business ability, manager, organizer, office experience and traveling. Address Box 96, Wilkes-Barre, Penn.

Graduate, age 32, shop practice, designer of eleven years' experience on special and automatic machinery, apparatus, fixtures, adding machines, typewriters, etc.; expert on new design, developing new machinery, inventive and practical, desires responsible position where the best man only will do. Box 955, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted—Skilled toolmakers on punches and dies; steady work; wages from 35c. to 45c. per hour. Apply Canadian General Electric Co., Peterboro, Ont.

Wanted—First-class man to set piece work price and time limits. Apply, giving experience and qualifications to Canadian General Electric Co., Peterboro, Ont.

Wanted—Energetic and experienced man to take charge of machine shop and blacksmith shop, in Canada, with about sixty hands, connected with large manufacturing concern; man wanted with good knowledge of modern methods and capable of handling men. Apply with references and particulars regarding experience, stating age and wages expected. Box 961, AMERICAN MACHINIST.

CONNECTICUT

Wanted—Young mechanical engineer and draftsman. Box 968, AMERICAN MACHINIST.

Wanted—Experienced mechanical draftsmen for detail work, in a concern manufacturing general rolling mill and hydraulic machinery; state age, experience and salary expected. Box 796, AMERICAN MACHINIST.

Wanted—In every machine trade center, a live man, with trade acquaintance, to sell a high-class and money-saving tool, already widely used and advertised; give age, experience and references. Box 888, AMER. MACH.

ILLINOIS

Punch and diemakers; men with experience on dies for watch parts and familiar with master plate system; eight-hour day and good wages; give experience and wages wanted. Box 967, AMERICAN MACHINIST.

Wanted—Diemakers; high-grade men for small accurate work; toolmakers for gage, jig and fixture work; milling-machine operators for tool-room work; automatic screw-machine operators for Brown & Sharpe and other automatic screw machines; on this line of work we pay competent men 39 cents per hour; added premiums will make this rate average 42 cents per hour; hand screw-machine operators. In answer give full information. Address Department 1056, Western Electric Company, Chicago.

INDIANA

Wanted—A mechanical draftsman; one who has had experience in the construction of stamping presses and dies; give experience, age, reference and state if married or single; the position offered is in a western town and will be a permanent one to the right man. Box 975, AMERICAN MACHINIST.

MASSACHUSETTS

Wanted—First-class draftsmen. Apply Supervisor of Drafting Room, General Electric Co., Pittsfield, Mass.

Salesmen wanted to handle movable grates for steam boilers in New England; salary and commission basis; men with engineering experience or education preferred; state fully qualifications and salary expected. Box 958, AMERICAN MACHINIST.

Wanted—A practical pump man; one who can design, estimate power, efficiency and cost and superintend construction; would prefer a man who has had experience in steam engine and electrical work in connection therewith. Address, giving age, experience and references. "Pump," AMERICAN MACHINIST.

Wanted—General manager's assistant in an established trade, from 30 to 40 years old; up-to-date general mechanical and business ability on estimating, cost accounting, etc.; one with shop experience preferred; executive ability, quick and energetic. Applications in writing only, stating terms, and with references, Boston Gear Works, Norfolk Downs, Mass.

Foreman blacksmith wanted in forge department employing 25 hands on large and small engine and general marine work, also tool and furnace work; must thoroughly understand nickel steel, crucible steels, high-speed steels and be able to get out work from the men promptly according to blueprints, specifications and date; only an energetic, experienced executive familiar with modern shop methods will be considered; state age, experience and salary expected; correspondence confidential. Address 974, AMER. MACH.

MICHIGAN

Wanted—First-class machine designer and draftsman; one experienced in woodworking lines. Box 959, AMERICAN MACHINIST.

Wanted—Ten first-class toolmakers who have tools and understand jig and fixture work; customary wages. Box 936, AM. MA.

Wanted—First-class tool-room foreman on jigs and fixtures; one who can get rapid and accurate production from a first-class equipped tool room. Box 935, AMERICAN MACHINIST.

MISSOURI

Wanted—Mechanical draftsman who has had experience designing woodworking machinery; state age, experience and give references. Apply Box 938, AMER. MACHINIST.

Wanted—An experienced man as foreman of machine shop employing about 100 men, who thoroughly understands the manufacture of woodworking machinery; must have occupied similar position; applicant will state age, experience and give references. Box 937, AMERICAN MACHINIST.

NEW JERSEY

Wanted—Four experienced draftsmen on gas engines; state experience, reference and salary expected. Box B, AMER. MACHINIST.

Technical man for position traveling engineer; must be familiar with automobile designs; shop experience preferred; headquarters in Detroit; give full particulars regarding experience. Address Dept. H., Box 476, Newark, N. J.

NEW YORK

Good header men wanted for night work; good pay, steady job. Box 918, AM. MACH.

Draftsmen familiar with engine and boiler work. State age, experience in detail, references and salary expected. Box 977, AM. M.

Wanted—Two or three first-class diemakers on small and medium blanking, forming and drawing dies for tin boxes. Box 933, AM. M.

Wanted—First-class draftsman on steam turbine work; state experience and salary expected. Kerr Turbine Co., Wellsville, N. Y.

Designers wanted, experienced on fine gage, jig and fixture work; give detail of experience, age and rate expected. Box 941, AM. M.

Wanted—Experienced toolmakers on fixtures and gages; state experience, age and rate per hour expected. Remington Arms Co., Ilion, N. Y.

Toolmaker with thorough experience of jigs, fixtures and tools, experimental and fine instrument work, wishes position; best references. "Omega," AMERICAN MACHINIST.

Wanted—Planer hands, lathe hands and all-round machinists; steady job; no strike; state experience and wages wanted. Address W. B. Peirce, 169 Vandervoort St., North Tonawanda, N. Y.

Wanted—A thoroughly competent web printing press draftsman; man of experience and ability can have permanent position at high salary; communications confidential. "W. W. C.," AMERICAN MACHINIST.

Wanted—For stove plant near Chicago, an assistant superintendent, college graduate preferred; practical experience essential, either foundry machine shop or sheet steel stamping shop. Address H. P. G. N., AMER. MACH.

Wanted—First-class floor inspectors for drill press, milling and bench work; top price paid to steady competent men; no others need apply; nine-hour shop. Apply E. R. Thomas Motor Company, Buffalo, N. Y.

Thoroughly experienced man wanted to assume complete charge of stores, shipping and receiving in plant manufacturing motor vehicles; state age, nationality, experience in detail and salary expected, addressing Box 973, AMERICAN MACHINIST.

Wanted—Clerk for drafting room in engineering works in small town western New York; to enter and index drawings, superintend filing, copy lists of quantities, etc. Give fullest particulars and state salary, addressing Box 939, AMERICAN MACHINIST.

Wanted—First-class hand screw machine foreman; job also includes two Brown & Sharpe and one large sized Gridley automatic; man must be resourceful and first-class handler of help; good pay to the right party. Box 960, AMERICAN MACHINIST.

Wanted—Foreman to run rough grinding, polishing and buffing department in a large automobile factory; must be a man who has held similar position and one who can produce results. Address H. A. G., Care Frank Seaman, Inc., 30 West 33rd St., New York City.

Wanted—Experienced man in time study and planning work in connection with a manufacturing business; opportunity is limited only by the efficiency of the man; state experience and salary expected during the period of becoming familiar with business and demonstrating of ability. Box 944, AM. MA.

Wanted—By machine tool works in prosperous city of 200,000 experienced foreman, now employed, preferably not over 30 years of age, for machine department having 40 men; must be up-to-date on production by interchangeable method; good opportunity for right man; give age, nationality, experience, salary expected and reference. Box 969, AMERICAN MACHINIST.

OHIO

Two machinists and two toolmakers wanted. Box 978, AMERICAN MACHINIST.

Wanted—First-class machinists; no labor troubles. The Heisler Co., St. Marys, O.

High-class salesman to call on large manufacturers, foundries and pattern shops; references with first letter. American Specialty Mfg. Co., 3920 Superior Ave., Cleveland, O.

Wanted—Superintendent for factory building a full line of bakers' machinery; a man with previous experience in this line desired; particulars such as age, experience and salary wanted. Address Box 971, AMER. MACH.

Wanted—First-class sheet-metal man, capable of managing sheet-metal department in a large automobile concern; must be thoroughly experienced in punch and die work; state age, experience and salary. Box 945, AMERICAN MACHINIST.

Machinists—We are increasing our output and invite application from machinists with experience on planers, turret lathes, boring mills, milling machines, screw machines, etc.; state fully, experience and wages. Foos Gas Engine Co., Springfield, Ohio.

Applications wanted from erectors on pumps, compressors, etc.; also from planer hands; boring mills and big radial operators for heavy work; state wages expected, past experience and names of past employers. Z. Y. X., AMERICAN MACHINIST.

Production expert for large shop manufacturing compressors and other heavy and medium machinery; must be competent to devise economical method of machining and understand cutting tools thoroughly; applications considered only from those having experience and record in such work. A. B. C., AM. MA.

Wanted — First-class machinists, lathe, planer, brass molders, drill press, screw machine, boring and milling machine operators, die sinkers and patternmakers who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Building, Cleveland, O.

PENNSYLVANIA

Wanted—Toolmakers, machinists, assemblers and all kinds of first-class mechanics on automobile work. Box 934, AMER. MACHINIST.

Help Wanted—Designer and draftsmen on general machinery; first-class designer, capable of taking charge of work; also one draftsman wanted. Box 890, AMER. MACH.

Wanted—Particular and ingenious machinist for assistant foreman; shop manufacturing mechanics' tools; this is an opportunity for the right man. State experience and wages. Box 976, AMERICAN MACHINIST.

Tool designer wanted, having technical education, shop and drafting experience, familiarity with press and die work and automatic machinery, by Philadelphia concern engaged in drawn and stamped sheet metal manufacturing; salary $30 per week; engagement January 1; permanent position; state in detail, age, education, experience, married or single, references. Box 970, AM. M.

A Running Balance Machine

A Simple and Satisfactory Solution of a Long Standing and Puzzling Mechanical Problem Which Is of Constantly Growing Importance

EDITORIAL CORRESPONDENCE

The accompanying illustrations show a new departure in machine-shop practice—a machine by which perfect running balance of long revolving pieces of machinery may be secured. It is the result of extended use of an extemporized apparatus by the Norton Grinding Company, of Worcester, Mass., for giving the rapidly revolving members of their grinding machines a running balance. It is the belief of Mr. Norton that running balance is a far more important matter than is generally accepted. He believes that in many cases, notably automobile crank shafts, flywheels and clutches, the prevailing practice of giving these parts a standing balance only, frequently results in more harm than good and it is perfectly easy to conceive conditions which amply justify this belief.

Description of the Machine

Fig. 1 shows a front view of the machine with a shaft and wide-face pulley placed upon it in order to determine what needs to be done, in order to give it a running balance. The shaft rests at each end upon four rollers, two of which are plainly seen, which are mounted in suitable cradles, the cradles being, in turn, mounted upon the upper ends of vertical rods seen more clearly in Figs. 2 and 3. These rods rest upon steps which are adjustable vertically by the knobbed handwheels at the elbows of the supporting frames, the adjustment being for the purpose of leveling the shaft to be balanced and of suitably tightening the driving belt. The vertical rods pass through disks of rubber contained in the supporting knees whereby they are permitted to vibrate horizontally to a limited degree.

Multiplying pointers, shown plainly in Figs. 2 and 3, are so connected with the supporting rods as to vibrate with them and to magnify the vibration to the eye. Upon the extreme left of the supporting knees are two universally adjustable scriber points for marking the high places on the shaft as it revolves. To make these markings more distinct the shaft is coated with red paint by means of the little roller seen lying in its paint pot on top of the controller. The machine is driven by a variable speed motor as plainly shown, which is connected with the driving shaft by means of open and crossed belts whereby the shaft to be balanced may be driven in both directions for reasons which will appear later.

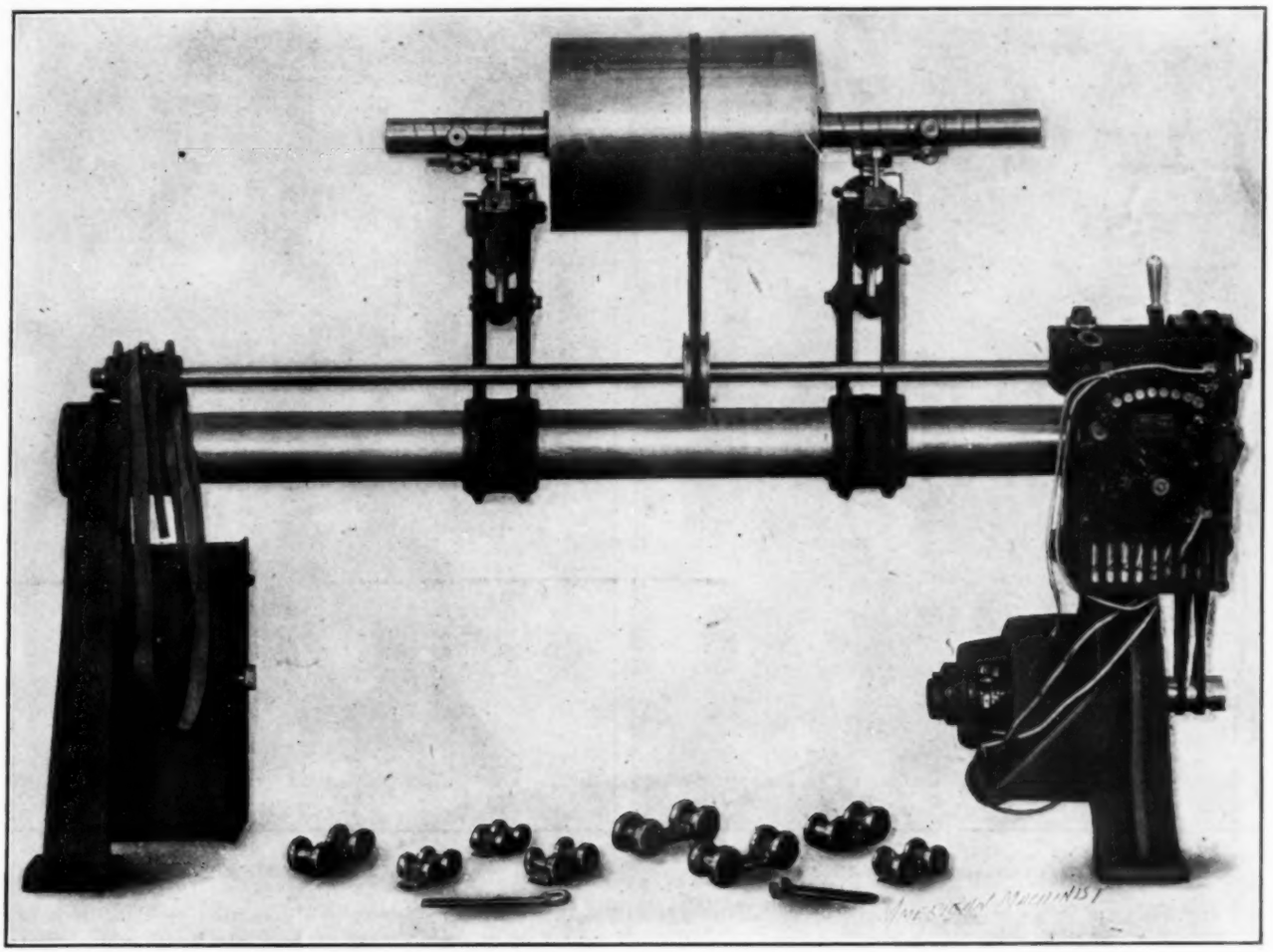


FIG. 1. THE NORTON RUNNING BALANCE MACHINE

The Operation of the Machine

After mounting a shaft in the machine it is put in motion and by means of the controller the speed is adjusted until the pointers vibrate to their maximum amount—this speed being that which synchronizes with the supporting rods considered as pendulums—about 200 revolutions per minute. At either slower or higher speeds than this the vibration of the pointers is reduced, and, indeed, if the speed be sufficiently high it will almost disappear. It is commonly stated and it is a fact that a revolving piece balanced at one speed is likewise balanced at all speeds, but this does not imply that the indications of lack of balance are the same at all speeds, or that they increase with the speed. The final effect is the result of force and resistance. With the speed of the shaft synchronized with the pendulum action of the supporting rods the resistance to the tendency to shake is at a minimum. The weight of the cradle to be shaken and the lack of synchronism causes this resistance to increase with the speed more rapidly than the tendency to shake and consequently the actual shake diminishes as the speed increases.

Interpreting the Indications

When the speed is thus adjusted to the maximum of vibration, the scriber is adjusted by the hand until it marks the point upon the shaft. Were it possible for the piece to revolve freely in space, as, for example, the earth revolves in space, the mark would indicate exactly the radial line on which a correcting weight must be added or removed, but under the condition of partial constraint which prevails in the actual machine, the mark is behind this radial line. It is for this reason that the shaft is made to run in both directions, since by thus testing it, two marks are made which lag equally behind the radial line which it is desired to find. With the two marks made, it only remains to divide the angle between them in order to find this line, and from some spot as near as possible to the end of the shaft on this line, but on the opposite side of the shaft; for in this machine the high side is the light side, a trial amount of stock is ground off, and the operation is then repeated. Figs. 2 and 3, both of which were taken with the machine in motion, show, by the condition of the pointer, the unbalanced and the balanced condition of an automobile crank shaft.

On the first trial the two pointers commonly vibrate although one more than the other. The end which behaves the worse is treated first and as it is corrected the other end commonly improves, the two pointers frequently coming to rest together.

Curious Behavior of Revolving Pieces

There are more things in running balance than most people have dreamed of in their philosophy, and it is a curious fact, which we will not attempt here to explain, that as the balance is improved the behavior of the piece to a certain extent reverses itself. As already stated, with a piece badly out of balance the pointers will vibrate more at the synchronizing speed than above it, but with the piece nearly balanced this ceases to be true, the vibration of the pointers increasing as the speed is raised above this point, and for the final test the pieces are thus driven at a good deal higher speed than in the beginning.

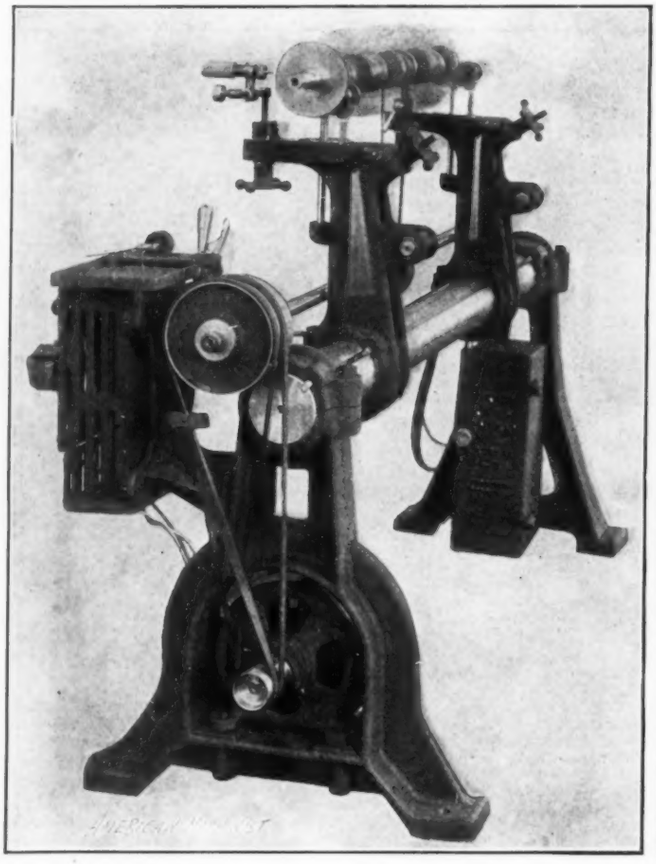


FIG. 2. AN UNBALANCED PIECE IN MOTION

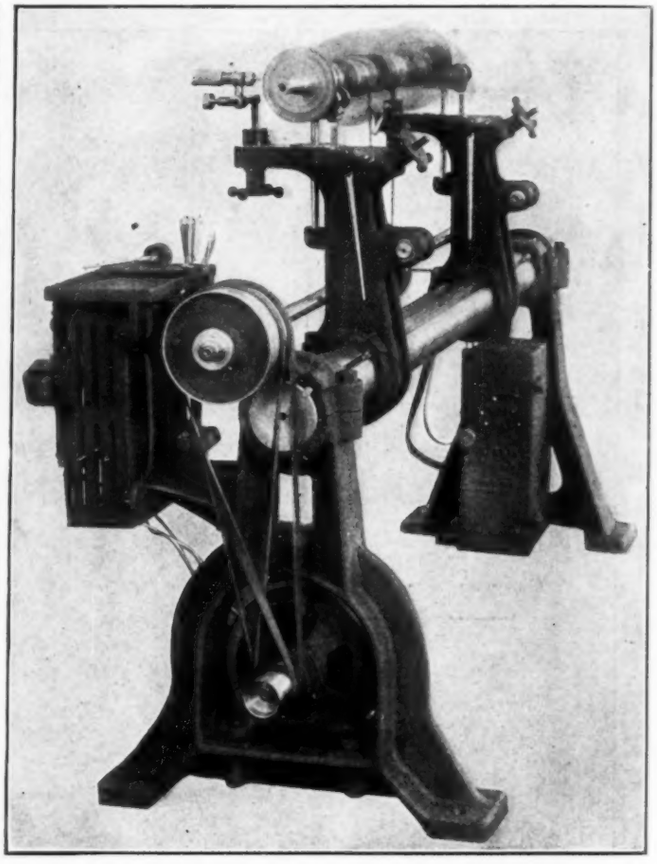


FIG. 3. A BALANCED PIECE IN MOTION

A new condition presents itself in the case of long six-throw crank shafts as shown in Fig. 4 in which an intermediate supporting knee with its recording scriber will be seen. With such shafts it is frequently found that after the ends are in perfect balance the middle will still be out of balance. This is no doubt due to the fact that, because the shaft is very slender and that it has considerable weights of metal revolving at a considerable radius, its critical speed is low, so that the slightest lack of local balance near the center throws it into vibration there, even though, as a whole, the shaft is in perfect balance. Whatever the explanation, the fact is undoubted and the

use of a central knee is frequently necessary.

Flexibility of the Machine

A comparison of Fig. 1 with the other illustrations will show that great flexibility is required in the matter of pulley ratios in order that the piece to be balanced may be driven at the proper speed. This is provided by an assortment of pulleys which are stored in the cupboard shown opposite the motor. These pulleys are split and have a single confining screw collar so that they may be quickly placed and secured in any convenient position upon the shaft.

Similarly in order to provide for balancing shafts of widely varying diameters a series of supporting cradles of various sizes are necessary and these are provided as shown in the foreground of Fig. 1.

While an explanation of the principles of running balance is necessarily somewhat involved and even obscure, the practice of putting parts in running balance, now that a suitable machine has been provided, is extremely simple. The subject is of constantly growing importance and the enterprise of the Norton Grinding Company in developing this machine should be followed by its wide adoption and a resulting improvement in many classes of rapidly revolving machinery.

An Electro Micrometer

By George J. Murdock

This tool is designed to meet the requirements of those who have experienced difficulty in obtaining accurate measurements of the inside diameter of bushings and other work when held in a chuck, where the hole is so small that the common inside micrometer cannot be used. While especially adapted to this purpose, it is also a superior device for obtaining correct results with the surface plate, and for general testing and comparison.

As herewith shown, it is the outcome of my own very urgent needs in the directions indicated, and moreover it has been my purpose to produce a tool of the greatest sensitiveness for precision work that must be so accurate as to defy criticism. It often happens on lathe work, but more frequently with the universal grinder, that a sleeve or bushing must be made exact either in parallelism or taper, and to take the work out of the chuck to measure the inside end is impracticable. Heretofore more or less unreliable means have been used to ascertain the truth of the job, all of which to the best of my knowledge, are wasteful of time and generally fail to give the results expected.

The human hand directed by a brain more or less fallible, cannot attain the extreme delicacy of touch that is inherent in electricity.

Terminals that are under proper conditions will show contact when they are brought together in a way that is marvelous, and the combination of the aural sense with the visual in using this tool adds to the toolmaker's ability to obtain correct determinations.

The Micrometer Head and Its Mechanism

An examination of the illustrations will disclose in Fig. 1 a plan view of the tool. A micrometer head *A* is attached to the hardened, ground and lapped frame *M* by

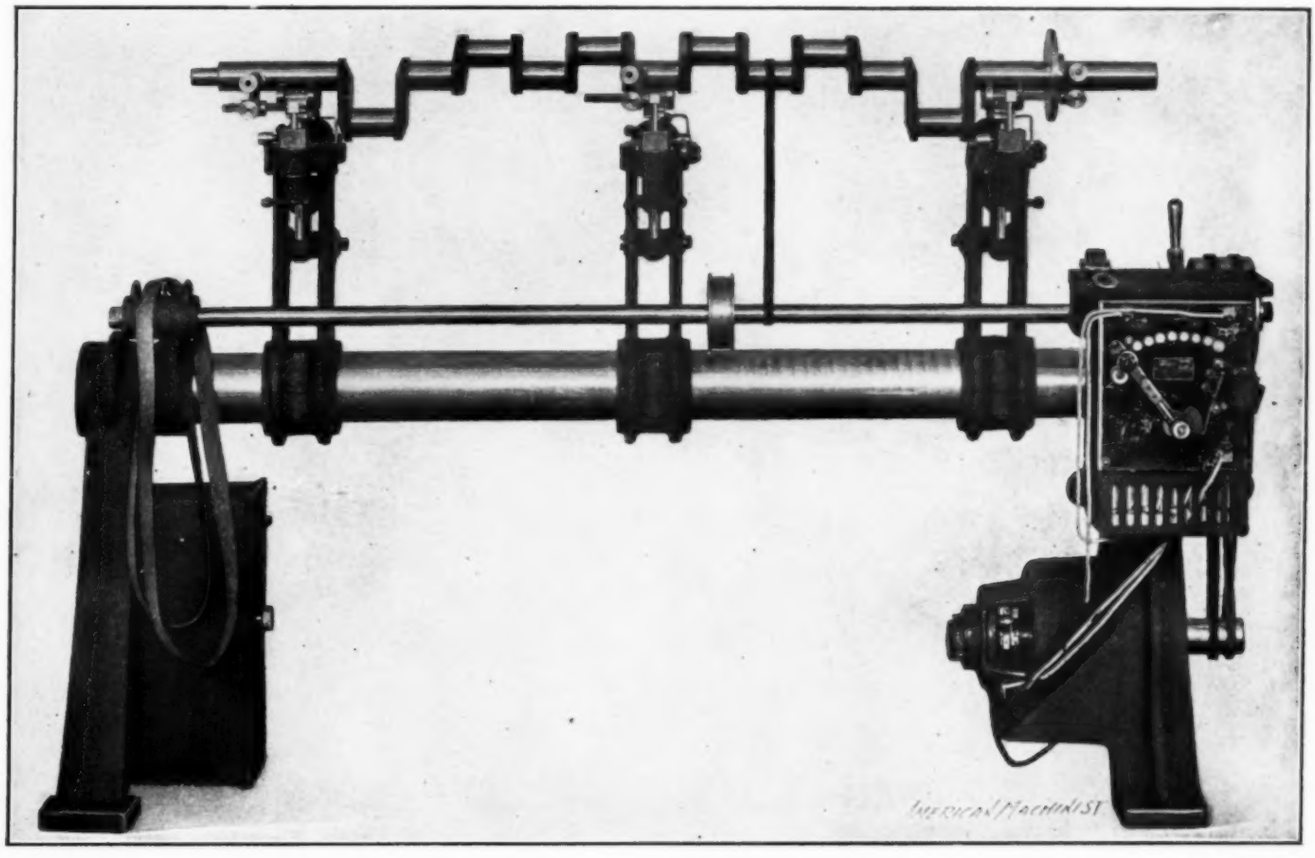


FIG. 4. BALANCING A SIX-THROW CRANK SHAFT

the nut *C*. The spindle is ground flat at *D E*, and carries a small spiral gear held to rotate with the spindle by the feather *F*, which is dovetailed into the gear. A second gear of 45 degrees angle meshes with the one on the spindle and is held in correct relation to this gear by a shaft at 90 degrees set in the bottom of the counterbored recess in the frame *M*, as indicated at *H* and by dotted lines *N*, shown in Fig. 2, which is a side elevation of the tool.

The shaft turning in hole *N* is solid with the gear, and is held in place by the screw *O*. In making these gears care should be taken to have them perfectly concentric at the pitch lines with the axis, and of exactly the same diameter, so that one turn of 0.025 of the thimble *A* of the

micrometer head will cause the gear *H* to turn precisely one revolution. As the uses for which the tool is designed never call for more than a few thousandths rotation of the thimble *A*, this ratio of the gears is permissible.

The Needle Bar and Holder

The top end of the shaft *K* enters a hole in the needle holder *I*, which is secured solid with the frame *M*, the use of which will be later explained.

It will be seen that the needle bar *I* will swing on *N* through an arc of 180 degrees, either vertical or horizontal, and will be at right angles to the micrometer spindle at 90 degrees, or when the micrometer thimble has turned 12½ thousandths. When finished the tool should be carefully calibrated by drawing a line from the top of

travel 0.040 inch out of parallelism with the axis of the spindle.

From this it will be seen that a movement of ⅛ of a thousandth of *A* (which is read from the vernier on the micrometer head) will effect a movement of 0.005 inch of the contact point 2 on the needle bar, magnifying the movement of the thimble *A* to such an extent that only a slight amount of travel is necessary to effect the pur-

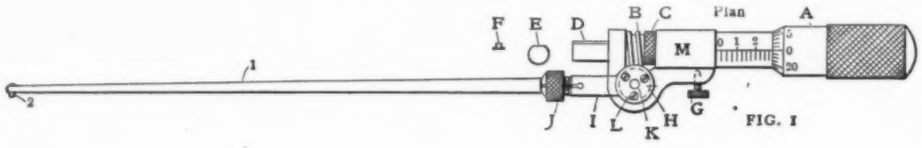


FIG. 1

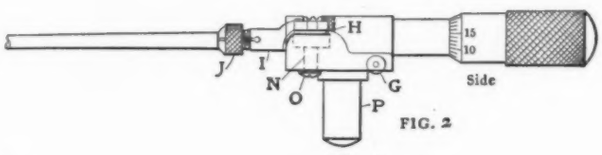


FIG. 2

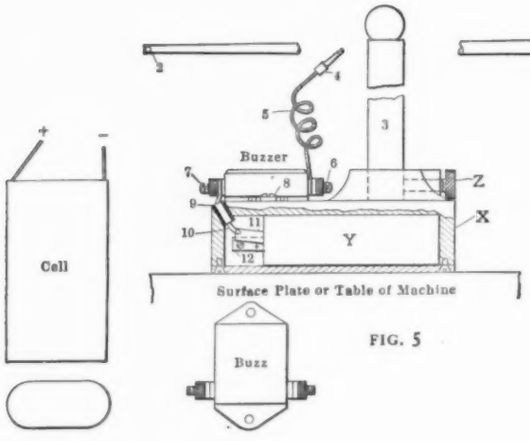


FIG. 5

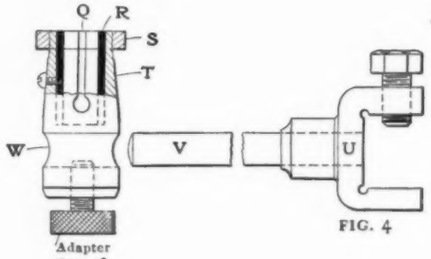


FIG. 3 FIG. 4

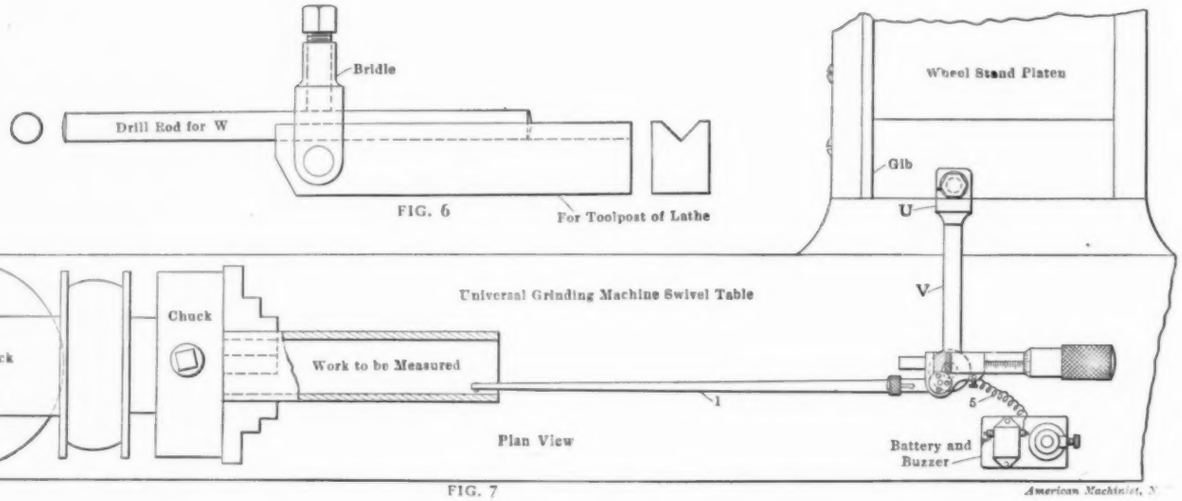


FIG. 6 FIG. 7

AN ELECTRO-MICROMETER

thereto by three watch screws, as shown in Fig. 1. The outer end of the needle holder terminates with a small chuck *J* which is made so as to grip the needle bar *I*. I have made this bar of aluminum rod uniformly tapered to secure both lightness and rigidity. At the extreme end of the bar is inserted a pin made with conical ends, and tapered so as to be driven firmly into a corresponding hole in the end of the bar.

A binding screw *G* is located on *M*, as shown, and a supporting stud *P* is made the needle-bar holder to the frame as indicated at *H* in Fig. 1, when the axis of the needle bar is parallel with the axis of the micrometer spindle, and the thimble *A* is at zero.

Sensitive Contact Point

In the tool made by me the distance from the center *K* to the center of the conical anvil 2 on the needle bar is such that a movement of 0.001 inch of the thimble *A* causes the contact point 2 to

poses for which the tool is designed. The long needle bar will reach into deep holes, and recesses where no ordinary instrument would have access.

Flexure of the needle bar is so extremely small as to be neglected if the tool is properly used. Temperature variation we always have with us to perplex, but even this can be taken care of with modern methods, so as to cause little trouble.

Holding and Clamping Devices

In Fig. 2 is shown the stud *P* heretofore

referred to, which fits with a slight taper the hard-rubber bushing *R* in the adapter *T*, Fig. 3. This is made with a nut *S* leading onto a taper screw thread, so as to close the chuck *Q* on *P* when it is inserted therein. This device not only electrically insulates the tool from the surface plate or machine on which it may be used, but further adapts it to be conveniently held for the various purposes for which it is intended.

In Fig. 4 is shown a device for clamping on the universal grinding machine where the rod *V* fits the hole *W* in the adapter. In Fig. 5 is shown a fixture somewhat resembling the base, and post of a surface gage in which the rod or post 3 also fits *W* of the adapter, while in Fig. 6 is shown a common round tool holder for the tool post of the engine lathe where the rod, being held therein by the bridle, also supports the adapter which is secured thereto by the screw *X'*, Fig. 3.

The Battery and Buzzer

In Fig. 5 are shown the devices for obtaining the aural notice that the contact point 2 of the needle bar is home on the wall of the work being measured. It is composed of the hollow cast-iron base *X*, battery cell *Y*, midget buzzer 8, and vertical post 3, which is secured in the hole by the screw *Z*. As before stated, the hole *W* in the adapter, Fig. 3, is made to fit the post 3 to which it is secured at any desired hight by the nurled screw *X'*. When the tool is attached by the stud *P* to the adapter which, for the purposes of this description is assumed to be on the post 3, it may be used for many of the jobs on which a surface gage is commonly employed, and especially those where accurate determinations are essential. The needle bar 1 can be turned in the chuck so that the point 2 will face in any desired direction.

I have made this point of platino-iridium wire which is not only very hard, but also resists the action of the electric current better than hard steel.

The Connections

The battery cell lies on its side in the base of *X*, occupying a space of only 2¼x1¼x¾ inches, and is of a type known as "Ever Ready," as used in small search lights. One terminal of the cell is secured by a screw 12 to the inner wall of the base, while the other terminal is attached to one pole of the buzzer 8 by a wire which passes through the hard-rubber bushing 9. The buzzer is known as a midget which has a clear and distinctly heard sound, yet not loud enough to be annoying. It is secured to the top of the base by two screws. After the cell is inserted in the base a cover is fitted, as shown, to hold it in place. The other pole of the buzzer is provided with a flexible cable 5 attached to the binding post, and has a brass tip 4 adapted to be held in electrical contact with the frame *M* by the screw *G*, Fig. 1.

It will now be seen that when the assembly is made on the post 3, and the tip 4 is in *M*, the surface plate and the work on it will constitute one terminal of the electric circuit, while the point 2 on the needle bar will be the other.

When the point 2 touches the work the circuit will be completed, and the buzzer will sound. If the base *X* is moved around so that the point 2 comes to a low spot in the work the buzzer will stop, and the truth of the surface can be readily ascertained by means of the micrometer in fractions of a thousandth of an inch.

Engine Lathe and Grinder Applications

For use on the engine lathe the base with the rod 3 removed can be set in any convenient place on the shears or carriage, and the cable 5 carried to the frame *M* on the tool which may be used for measuring holes being bored from the master plate, by the button method on jigs, or to locate work on the face plate, or ascertain the accuracy of holes being bored in work held in a chuck.

Fig. 7 is a plan view of a section of a universal grinding machine. The electro-micrometer is shown as being held by means of the adapter on the rod *V*, shown in Fig. 4. The clamp *U* is attached to the wheel-stand platen, and the adapter so located on the rod *V* as to bring the point 2 of the needle bar in line with the work to be measured, which in this case is supposed to be a sleeve 6 inches long by 1 inch internal diameter when finished, the hole to have its walls dead parallel, and of same diameter, at both ends. After the hole has been roughed the point 2 is brought against the wall of the hole at the outer end very carefully by rotating the micrometer thimble until the point 2 touches and the buzzer sounds. The work now being turned, if it is round the buzzer will continue to sound, but if in the least elliptical it will stop. If found round a reading is taken on the micrometer, and the point 2 moved away from the work by turning the thimble back. The swivel table of the grinder is now traveled along until the end of the needle bar is at the bottom of the hole, when the point 2 is again brought against the wall as before, and a second reading taken. A comparison of the two readings will show how much the hole is out of parallel, and the headstock can be turned for correction.

Taper Work and Other Considerations

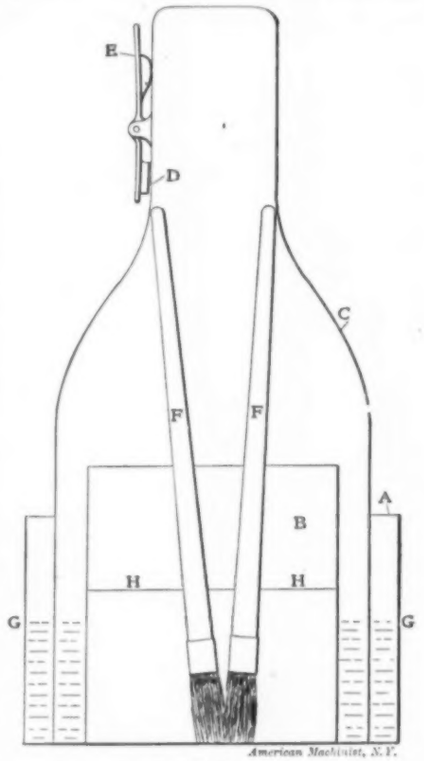
In grinding the hole taper the same plan is followed, only, of course, the reading would differ with the taper. Parallelism for the entire length can be ascertained by traveling the needle to varying locations along the hole.

The rod 3 is removed from the base *X*, Fig. 5, for the grinder as well as lathe work. The battery and buzzer are shown standing on the swivel table just beneath the micrometer, and the electrical connections and operations are precisely the same as when used on a surface plate or lathe. The battery cells will last a long time if used only for the purpose of measurements. No switch is required, as the circuit can only be closed under correct working conditions, or if accidentally closed the buzzer will at once give notice. There are other uses for this tool besides the ones heretofore enumerated, such as ascertaining the truth of arbors, setting up work on the planer or milling machine, and a variety of other applications which will suggest themselves to the practical toolmaker.

Patternmakers' Varnish Pot

By J. Watt

The line cut shows a varnish pot devised by the foreman patternmaker of the



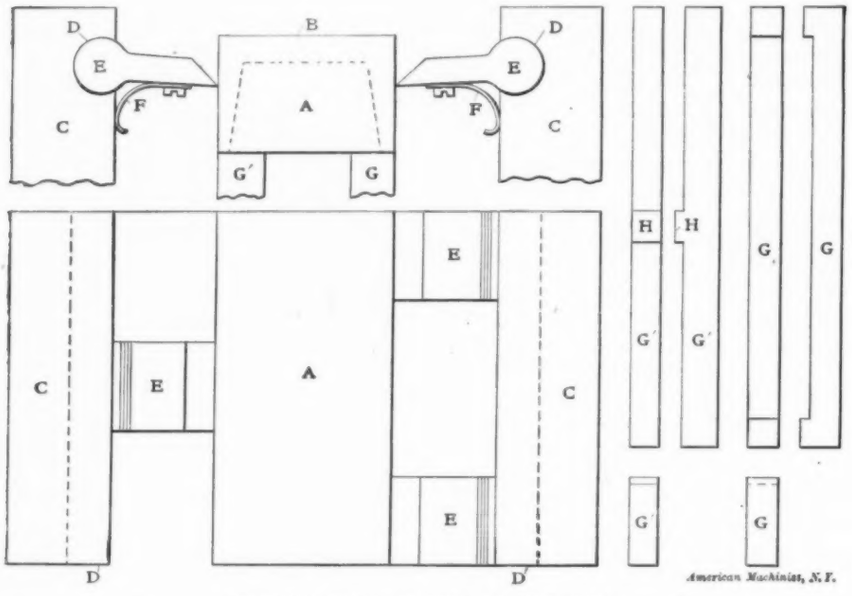
A VARNISH POT

Lowell Machine Shop, Lowell, Mass. The lower part consists of two brass pots, one within the other, fastened to a common bottom. *B* is the receptacle for the varnish. Between this and the outer pot *A* there is water to the level *G*, which acts as a seal and prevents evaporation. The cover *C* is also made of sheet brass, and its shape is such that it is not necessary to remove the brushes *F*. At *D* is a small air hole covered by the little lever valve *E* to let the air *out* when the cover is being put in place in the water seal and to let the air *in* when it is being removed. The position of the valve is such that the thumb presses *E* when handling the cover. This varnish pot has been in use for some time and is entirely satisfactory.

Gripping Work in the Shaper Vise

By E. A. Dixie

We had a large order for some small printing presses. One of the few particular parts was the platen *A* on which the paper is laid to take the impression from the type. The back of this is left rough, but the face *B* is shaped and should be fairly flat. We set the job up in the usual way in the shaper vise with a parallel close to each jaw for the job to rest on. Owing to excessive draft in the platen and the looseness of the moving jaw of the vise the results obtained were not at all satisfactory. To overcome the difficulty I made the rig shown. The steel faces of the vise jaws were removed and two new ones *C* made by drilling a half-inch hole from end to end at *D*. The jaws were then planed so that the side of the steel grips gave a three-point grip. Each grip was independent of the other and the tighter the vise was closed the firmer the platen was bedded on the bosses on the parallel strips. Very little pressure was necessary or used to hold the work and the result was all that could be desired. The platens came out nearly flat, say, 0.0015 inch of being flat, and a great deal better than was expected.

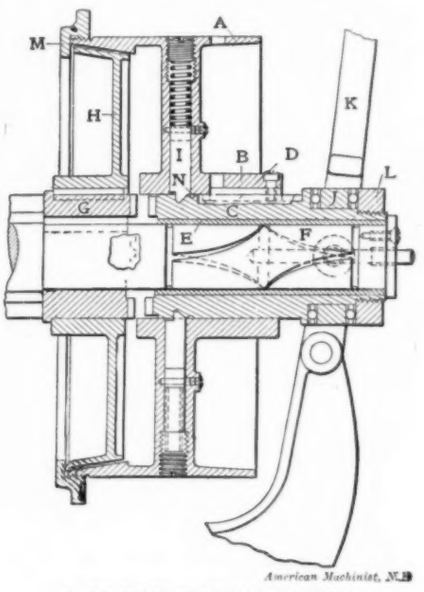


GRIPPING WORK IN THE SHAPER VISE

A Positive Friction Clutch

By H. F. Noyes

This clutch was designed to meet the need for a positive clutch which will readily engage at a speed of 300 or 400 revolutions, and is strictly what its name implies, a positive friction clutch. The drawing shows an application of the principle to a machine tool drive.



A POSITIVE FRICTION CLUTCH

half-inch hole was open. Three pieces of tool steel were made like *E* and flat springs *F*, of very light spring brass were fitted to what would be the under side of each of them. Two of the steel grips were then slipped into the hole in the solid jaw and one into the hole in the sliding jaw, the pieces having first been ground at an angle where they would grip the work, and tempered.

Two parallel strips *G*, *G'*, were then made. *G'*, the one next the sliding jaw, had a boss *H* about an inch long by the width of the strip left full hight in the center of its length, the rest of the strip was about ⅛ inch lower. The strip for the other side had two of these bosses so spaced that they were at two corners of the platen when in position for shaping. The three bosses gave a three-point support for the platens and the three

The driving pulley *A* has a large hub *B* which is fitted to slide upon a steel sleeve *C*, driving it by means of a feather *D*. A bronze bushing *F* is pressed into the sleeve and is adapted to run loose upon the shaft *F*, which is the main driving shaft of the machine.

A steel sleeve *G* is keyed to the driving shaft and a friction pulley *H* is keyed to this sleeve so that the friction, when driven, will drive the main shaft.

The driving pulley *A* is provided with an internal friction surface adapted to fit the conical surface of the pulley *H*. Both steel sleeves are fitted with clutch teeth of the usual form, adapted to engage each other.

The pulley *A* is provided with two spring-pressed plungers *I*, having beveled points adapted to fit corresponding recesses which are turned in the sleeve *C*; the drawing shows these plungers as seated in these recesses with the conical friction out of engagement. The sleeve *C* is fitted with a collar *J* held in place by a nut *L*, and a lever *K* fitted to the collar is adapted to move the sleeve longitudinally as may be desired.

The operation is evident. When the sleeve *C* is moved forward it carries the pulley *A* with it, until the latter engages the friction pulley *H*, being held in engagement therewith during the continued forward movement of the sleeve, starting up the shaft *F*, which by the time the sleeve has moved forward far enough for the clutch teeth to engage, will have attained sufficient speed for them to readily engage. After they have engaged the plungers *I* pass to the retaining recess *N*.

In disengaging, the sleeve clutch moves out of engagement first usually carrying the friction with it, unless it sticks, in which case the plungers after they are seated in their normal disengaged position draw the pulley with them. In case the plungers hang in the slight recess *N* a cap *M* is provided which also acts as a flange for the belt.

The advantages of this clutch lie in its simplicity and positiveness. It is compact and takes little room on the shaft, requires no adjustment and there is nothing to get out of order. The tension of the plunger springs may be readily varied to suit the conditions required.

The limit of speed engagement of two toothed clutches is under 200 revolutions. With this device I have readily engaged the clutches at a speed of 800 revolutions, and it is possible at a speed of 300 revolutions to throw these toothed clutches into engagement one would throw in a lathe clutch.

The principle is applicable to nearly all forms of machinery, with variations to suit the conditions.

The Scleroscope on Automobile Work—II

Commercial Testing. Relation, If Any, of Hardness to Elastic Limit, Elongation, Reduction and Tensile Strength; Also to Segregation. Failures

BY ALBERT F. SHORE

For testing metals, many different kinds of apparatus have been devised, most of which have their value in the laboratory. In the ordinary inspection room and general shop, however, the following are available:

Microscopic structure; hardness; tension; compression; shear; shock; wear and dynamic life by alternate stresses and bending.

When a certain heat of metal is to be tested and a number of special test pieces can be prepared, any one of the above methods could be used to advantage by an engineer, but if finished parts are to be tested it must be remembered that no test pieces can be cut off, nor can we break a piece off to see how much power of resistance it shows, what the grain of the metal looks like, etc. If these things could be done, the time required would prohibit the practice entirely anyway. The test to be practical must not mar the work and must not consume more than a few seconds of time, so that such parts as ball races, important gears, and the like may be tested in a number of places to ascertain the uniformity, in addition to the standard hardness.

These things according to the decisions of many establishments are all performed satisfactorily by the scleroscope and in consequence such firms as the Packard Motor Car Company, Brown & Sharpe Manufacturing Company, Hess-Bright Manufacturing Company, Hyatt Roller Bearing Company, etc., have in constant use in their inspection department and laboratory a number of such instruments. In some instances women are employed to test many small parts.

Hardness vs. Elastic Limit

If a test bar be pulled apart and the hardness is uniform the bar usually parts midway between the two enlarged ends gripped by the machine.

If the hardness varies only 10 points along the said bar, it is sure to fail and part on the soft portion, regardless of location, because there the elastic limit is lowest. In other words, it is so much the weaker that while the strain on the harder portion is just enough to cause it to spring, the other part is elongated, reduced in area, and thus parts very quickly.

This condition has enabled some engineers to work out hardness indexes that show what the tensile strength is on a given material; one of which is shown in Fig. 5. While this works admirably in practice, it would not be feasible to get out a standard table of hardness that would be used in general to determine tensile strength.

Looking at this practice from the chemical view point, a steel with the proper amount of carbon in a pure iron may be made 35 hard, while another having less carbon may acquire just the same hardness through a foreign and injurious element, such as phosphorus and yet the strength would be much the greatest in the former. Hence, to find a strength equal to and in proportion to a given hardness number, the chemical constitution must be known.

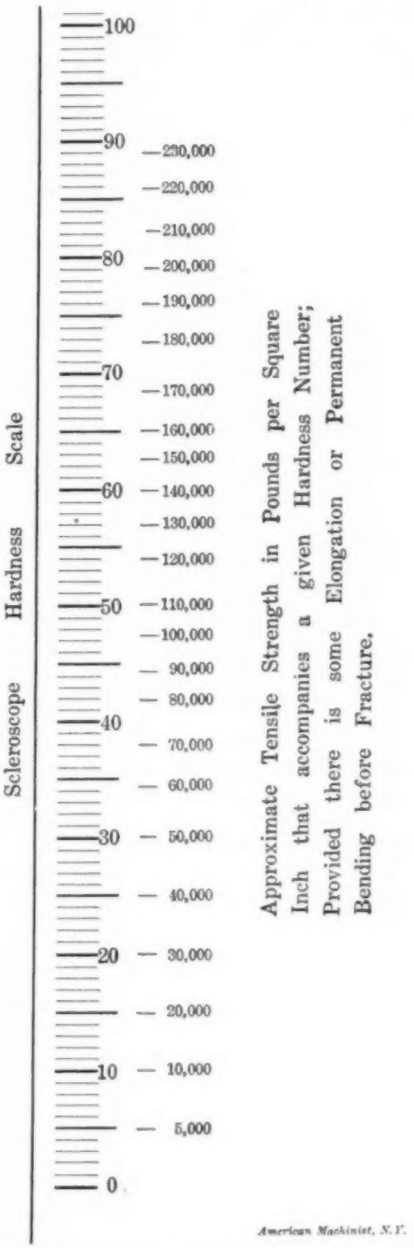


FIG. 5. HARDNESS VERSUS TENSILE STRENGTH

Elongation Tests

When it is not feasible to obtain the correct chemical analysis, tests showing the elongation of the material are made. The object of this is to test for brittleness. Thus, if a metal measured 60 hard and was very brittle, the pull-test machine would show a very low elastic limit, and no elongation. This shows that failure ensued before the full elastic limit was reached.

These facts indicate that the hardness measure of either the scleroscope or the Brinell ball test—when the latter is applied properly—indicate not only hardness but also the elastic limit, meaning practically the load a given metal bar will carry before taking on a permanent set or deformation, provided the ductility at such a hardness is known.

The methods employed for testing ductility and elongation are by the pull or single-stress machine, or by bending a strip or bar in a compound-stress device. In the former the per cent. of elongation is noted, while in the latter the number of degrees of permanent bending up to the breaking point is noted. These latter tests are fully as important, if not more so, than the chemical analysis test, for then all chances for error are eliminated.

Metals under Stress

When a load is applied to almost any kind of the commercial metals, it is a strange fact that all, whether copper or hardened steel, show about the same rate of flexure under the same stress up to the elastic limit or permanent set point.

This peculiarity shows that the behavior of metals under stress is due to the obedience of some laws. The first law is quite fixed much to the regret of engineers, who would prefer the harder metals to be much more stiff than they really are.

The second law is somewhat less rigid than the first and fixes the length of the elastic limit curve. This is found to be directly in proportion to the property known as hardness.

The third factor of vital importance is the elongation or degrees of permanent bending a bar will stand at a sharp angle, without breaking. Almost exactly contrary to the nonvariable responses ob-

tained from all kinds of metals before the elastic limit, each will show their individuality after the elastic limit, until the ultimate strength is reached. These curves, now most commonly obtained by the single-stress machine and defined as elongation and reduction of area, are really the tell-tale lines of the peculiar nature of any metal.

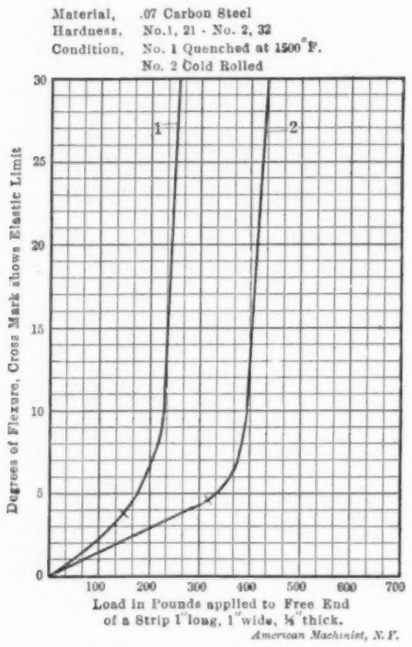

Material, .07 Carbon Steel
Hardness, No. 1, 21 - No. 2, 32
Condition, No. 1 Quenched at 1500° F.
No. 2 Cold Rolled
Degrees of Flexure, Cross Mark shows Elastic Limit
Load in Pounds applied to Free End of a Strip 1" long, 1" wide, ¼" thick.
American Machinist, N.Y.

FIG. 6. GOOD ELONGATION, POOR HARDNESS

Properties Desired for Automobile Parts

In the construction of automobiles and like high-duty machines where lightness is to be desired, the first things to be called for are great strength and elasticity, so that when ditches and rocks are jumped none of the parts suffer distortion.

When these overload stresses are often repeated the strongest metals gradually become fatigued, or rather they become brittle by crystallization. Here is where the elongation curve comes in. Suppose we started out with an axle about 60 hard, an elastic limit of 110,000 pounds per square inch, and a tensile strength without elongation. As soon as this axle starts to crystallize, its elastic limit lowers, until at last it will break under but part of the load it could carry at the outset.

Had this same axle possessed a considerable elongation in addition to the high elastic limit, it would not be immune to fatigue, but the vitality would be sapped from the elongation or ductility factor. Since it requires a very long time to use up the ductility factor in a metal not grossly overloaded, it can be seen plainly that the more elongation a metal has at a high and useful hardness, the longer will be its dynamic life.

Elongation and Elastic Limit

Fig. 6 shows some curves obtained by a compound stress or bending machine, that possess the desirable elongation lines but have a worthlessly low hardness.

Fig. 7 has too much hardness and no elongation at all.

Fig. 8 is a very pure mild steel heat treated to bring out a high elastic limit. It also has a high elongation.

Fig. 9 is an alloy steel containing only chrome and carbon, which has an enormous strength but lacks ductility.

Fig. 10 is a carbon vanadium axle steel combining a prodigious elastic limit and the desired elongation also.

Fig. 11 is a standard nickel-carbon steel for axles combining nearly the same properties as Fig. 10, but being softer, its elastic limit is lower and the elongation while high, does not mean so much. It is nevertheless regarded as a uniformly reliable and powerful steel for automobiles.

Fig. 12 is the typical curve obtained from chrome-nickel steel containing about 0.30 carbon. This steel meets the exacting requirements of the automobile manufacturers so well that it is by far the most commonly used, and not infrequently for nearly all high-duty parts.

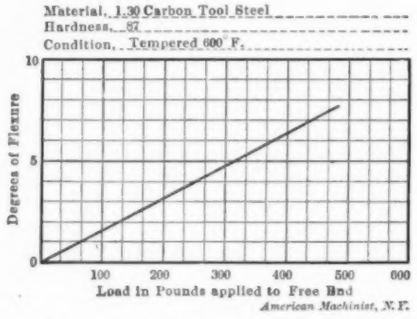

Material, 1.30 Carbon Tool Steel
Hardness, 67
Condition, Tempered 600° F.
Degrees of Flexure
Load in Pounds applied to Free End
American Machinist, N.Y.

FIG. 7. TOO HARD, NO ELONGATION

Cause of Low Elastic Limit

As we have seen in the foregoing, all metals useful to engineers, give a straight line as the stress is gradually increased until the elastic limit is reached. Steel under certain conditions, however, does not give this perfectly straight line. The straight line obtained by the bend test, means that so long as it runs, the metal will recover perfectly after the removal of the strain. When the line is curved, before the usual sudden elongation, as in Fig. 13, the indications are that the metal takes on a permanent set almost as soon as any kind of load is applied, see also curve 1 in Fig. 6.

This condition appears to be due to the suspension of hard crystals in a soft mass. Thus, curve 1 in Fig. 6 is a dead soft steel (0.07 carbon) quenched, while Fig. 13 is a 5.38 per cent nickel steel containing about 0.18 carbon, that was also quenched, but having more carbon it hardened more. Fig. 8 is a plain low phosphorus, 0.27 per cent. carbon steel quenched, that showed similar tendencies but to a less degree. When the latter is case-hardened the satisfactory curve in Fig. 14 is obtained. The curve in Fig. 13 is after case-hardening also, and is not satisfactory. This steel would not be hardened above 75 no matter how deep the cementation.

Some Causes of Failures

Notwithstanding the great care used in the selection of material for the construction of automobiles, as well as the heat treatment which steels usually get, occasionally mysterious failures occur. These failures are usually traced back to heterogeneity or segregation in the raw material, and also ununiform hardening or heat treatment. Segregation of different ingredients in steel rails was but recently the cause of many of them splitting or breaking and this resulted in many serious train accidents.

It consequently attracted the attention of railroad and steel experts, and researches were made to conquer this trouble, and now very few accidents can be traced back to nonhomogeneous metal in rails, because of the improvements that have already been made. The same can also be said for the finer alloy steels which form the principal theme of this discussion.

Manufacturers, however, prefer to take no chances and thus make very careful tests on their steel. Tests for segregation as performed by the leading engineers both for railroad and automobile work are made by taking hardness readings at intervals of about ⅛ inch across the bar and for some little distance lengthwise.

If the readings show fairly uniform either way then no trouble is indicated, although if there are radical variations the metal is not fit for high-duty work. In Fig. 15 is shown the effect of carbon segregation in mild steel. The heavy

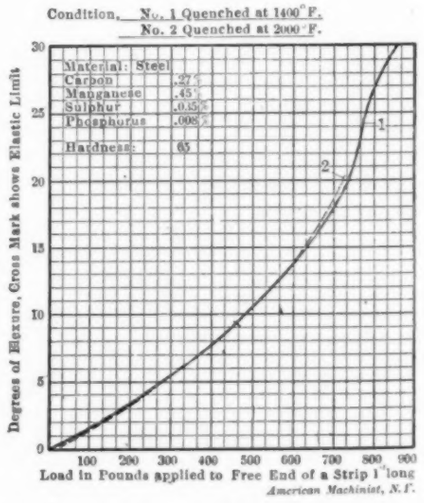

Condition, No. 1 Quenched at 1400° F.
No. 2 Quenched at 2000° F.
Material: Steel
Carbon .27%
Manganese .45%
Sulphur .035%
Phosphorus .098%
Hardness: 65
Degrees of Flexure, Cross Mark shows Elastic Limit
Load in Pounds applied to Free End of a Strip 1" long
American Machinist, N.Y.

FIG. 8. TREATED FOR HIGH ELASTIC LIMIT

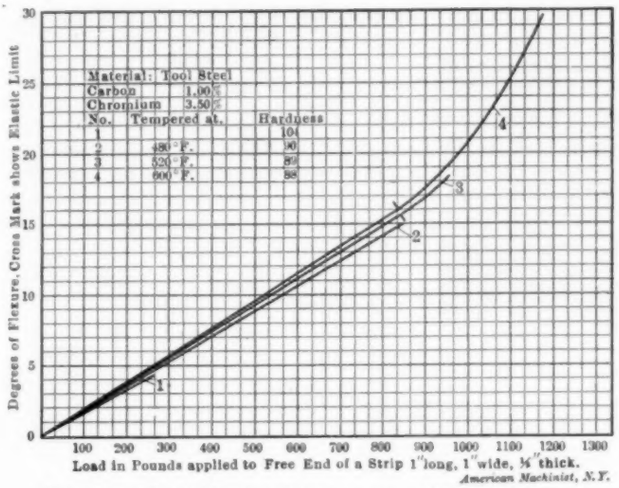

Material: Tool Steel
Carbon 1.00%
Chromium 3.50%
No. Tempered at. Hardness
1 104
2 480° F. 90
3 520° F. 89
4 600° F. 88
Degrees of Flexure, Cross Mark shows Elastic Limit
Load in Pounds applied to Free End of a Strip 1" long, 1" wide, ½" thick.
American Machinist, N.Y.

FIG. 9. ENORMOUS STRENGTH, BUT POOR DUCTILITY

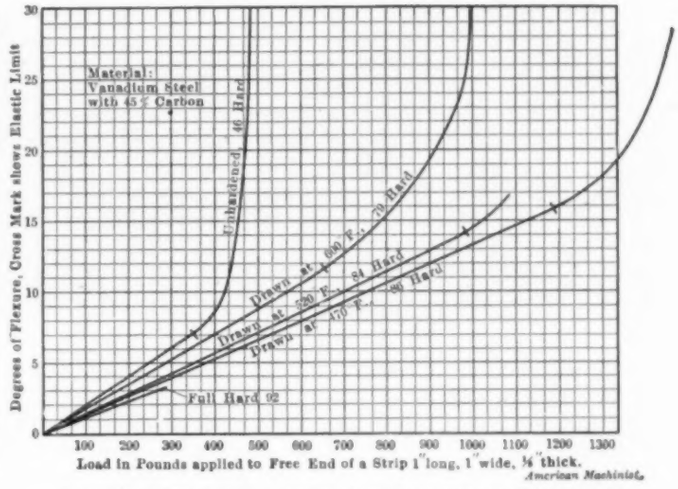

Material:
Vanadium Steel
with 45% Carbon
Unhardened 46 Hard
Drawn at 490° F. 79 Hard
Drawn at 530° F. 84 Hard
Drawn at 570° F. 89 Hard
Full Hard 92
Degrees of Flexure, Cross Mark shows Elastic Limit
Load in Pounds applied to Free End of a Strip 1" long, 1" wide, ½" thick.
American Machinist.

FIG. 10. VERY HIGH ELASTIC LIMIT AND GOOD ELONGATION

straight line shows a uniform combustion of the carbon with the iron, while the irregular dotted line shows carbon segregation with the accompanying soft iron streaks.

Structure Due to Heat Treatment

Perhaps no less important than the homogeneity of metals, which is dependent on the perfect mixing of the chemical constituents, is the depth and uniformity of the sorbitic and martensitic structure due to heat treatment. The sorbitic is due to only slightly hardening steel by quenching or cooling in a cold air blast, steam, molten lead, or oil; while the martensite is caused by hardening outright in water for large pieces and oil for small pieces.

An engineer may thus call for an alloy steel axle, which should have an elastic limit of 140,000 pounds per square inch and harden and temper the part so that eventually a hardness of 60 is shown.

If the hardness of 60 is only ⅛ inch deep and the interior is about half as hard, then his calculations will go wrong, for the greater section will only be half as strong. In order to harden deep, it is necessary to heat the pieces clear through and at the highest heat that the steel will safely withstand and quench in water. The carbon in the alloy steel thus treated seldom exceeds 0.40 per cent. and therefore, particularly when chrome is present, a temperature of 1550 degrees Fahrenheit will not harm the steel at all. In Fig. 16 is shown just what happened to a nickel-steel axle when thus heat treated to harden all through.

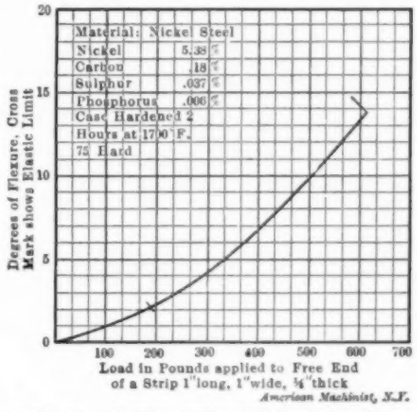

Material: Nickel Steel
Nickel 5.38%
Carbon .18%
Sulphur .037%
Phosphorus .000%
Case Hardened 2
Hours at 1700 F.
75 Hard
Degrees of Flexure, Cross Mark shows Elastic Limit
Load in Pounds applied to Free End of a Strip 1" long, 1" wide, ½" thick
American Machinist, N.Y.

FIG. 13. TAKES PERMANENT SET SOON

Hardness Variations

The E. R. Thomas Motor Company, after making breakdown tests on ball-bearing rings, found that if the overload is 100 per cent., certain failure will be caused by the hardness varying from 70 to 85, in one or another part of the same ball groove. The number of revolutions obtained under these circumstances was 1,500,000, and then the shell broke to pieces.

When thus hardness variations exist in a part having surfaces exposed to the kneading action of balls or rollers, there will be a tendency for the metal to yield, more or less according to the hardness. Thus, it will follow that if the variation is only 10 to 15 per cent. below the soft limit, ridges are formed which grow rapidly and which either smash the balls or rollers or the shells containing them.

Elongation and Reduction

The experience of works engineers who have to make tensile tests and who expect to be guided by the elongation and reduction of area which must be known in addition to the elastic limit, has shown

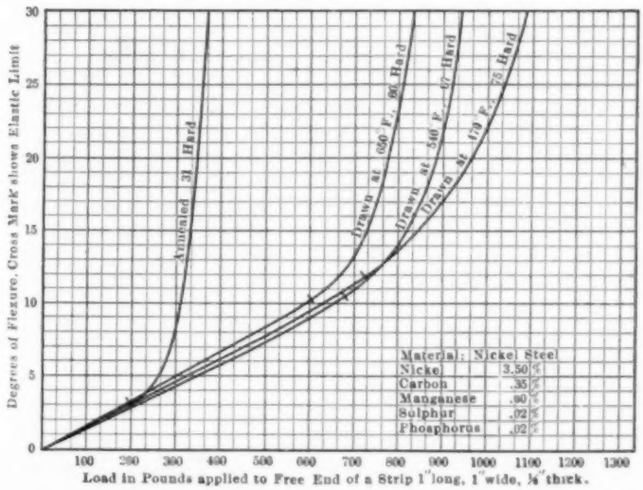

Annealed 31 Hard
Drawn at 650° F. 66 Hard
Drawn at 560° F. 67 Hard
Drawn at 470° F. 75 Hard
Material: Nickel Steel
Nickel 3.50%
Carbon .35%
Manganese .80%
Sulphur .02%
Phosphorus .02%
Degrees of Flexure, Cross Mark shows Elastic Limit
Load in Pounds applied to Free End of a Strip 1" long, 1" wide, ¼" thick.

FIG. 11. HIGH ELONGATION, BUT LOWER ELASTIC LIMIT THAN FIG. 10

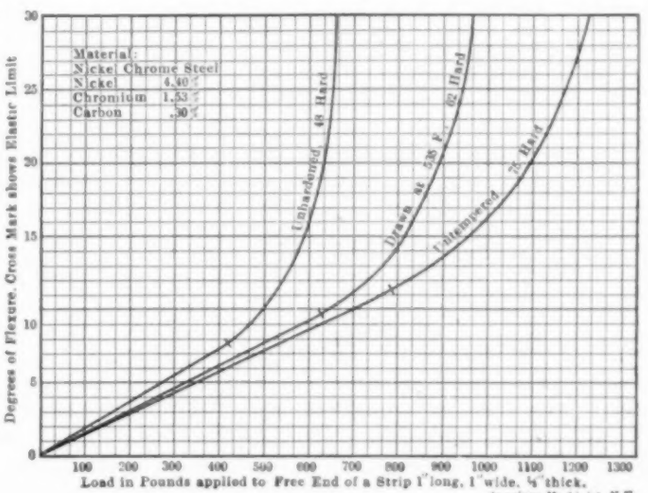

Material:
Nickel Chrome Steel
Nickel 4.40%
Chromium 1.53%
Carbon .30%
Unhardened 48 Hard
Drawn at 525° F. 62 Hard
Unhardened 75 Hard
Degrees of Flexure, Cross Mark shows Elastic Limit
Load in Pounds applied to Free End of a Strip 1" long, 1" wide, ½" thick.
American Machinist, N.Y.

FIG. 12. STEEL USED TO A LARGE EXTENT IN AUTOMOBILES

that frequently the readings obtained by one man cannot be duplicated by another, using a test bar of the same piece.

Sometimes the elastic limit varies and other times the elongation changes following, up to the ultimate, are all out of proportion.

These discrepancies have been traced to the heterogeneity of the material. If thus the test bar shows a uniform hardness all along, the percentage of elongation will have a relation to the reduction of area at the break which will be easily recognized as natural. When the hardness varies there is sometimes a great reduction of area with scarcely any elongation and this is particularly misleading when the elongation in so many inches is given while really only the softer segregation alone does all the yielding.

Carbonized Steel

The question of uniformity of hardness, contrary to what is generally supposed, enters also into the art of case-hardening to a large extent. It was formerly supposed that all that was necessary was to use a soft core and a good hard case to resist wear. Much practice shows that in reality there is a narrow safety line here and after all too great care cannot be taken.

If the soft core were a metal in a normal state so that under stress a

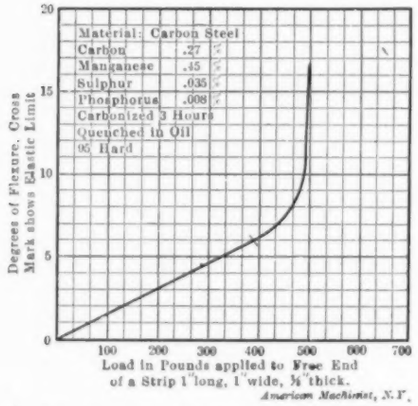

Material: Carbon Steel
Carbon .27 %
Manganese .45 %
Sulphur .035 %
Phosphorus .008 %
Carbonized 3 Hours
Quenched in Oil
95 Hard
Degrees of Flexure. Cross Mark shows Elastic Limit
Load in Pounds applied to Free End of a Strip 1" long, 1" wide, ½" thick.
American Machinist, N.Y.

FIG. 14. SAME STEEL AS FIG. 8, BUT CARBONIZED

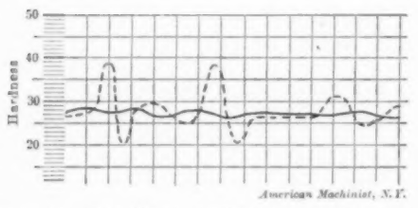


FIG. 15. HARDNESS SHOWING SEGREGATION

straight yield line were produced, then the modulus of elasticity would be approximately the same in the glass hard case and they would shoulder the load on equal terms and together would resist shocks.

When the carbon is as low as 0.10 or even 0.15 per cent. the tendency shown in curve 1, Fig. 6, will menace the endeavor for reliable results, as the hard case will take more than its due share of load and consequently crack. Cracks are equivalent to a nick and soon cause further breakage in the core. Where very soft steel is used, the case must be so thin that the former's modulus of elasticity is to be entirely figured on, so that when the cracks in the case do appear, they are of little consequence. This, however, would make a poor job owing to the ease with which the parts are battered.

This argues in the favor of a high-carbon steel for the case, that may run from 0.20 to 0.30 per cent. carbon, the lower being preferred for parts having very small projections and the higher for heavy work; 0.20 carbon steel when quenched in water hardens up to 50, while 30 carbon hardens up to 70. When quenched in oil as is usually the case for

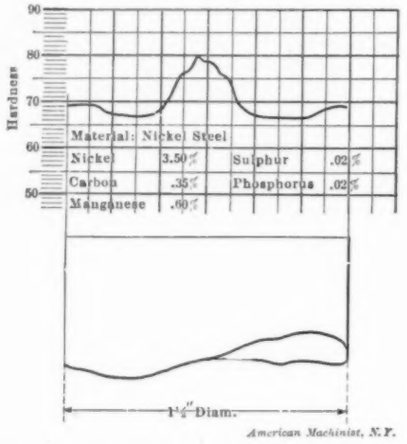


FIG. 16. HARDNESS ACROSS CENTER OF AXLE

gears, the hardening does not go much deeper than that of cementation save for the stiffening or sorbitic formation.

Tim came from Antrim and the first job he got in this country was in the shop in which I was foreman. He had been a farm laborer and what he didn't know about a machine shop would fill many volumes. I took him round the long row of automatics and told him that the chips were to be removed before they piled up high enough to fall out of the pans on to the floor. A little while later I saw him talking to one of the operators who had a broad grin on his face. Anything really funny is rare in the average shop and because of the solemn nature of the operator I knew it must be really humorous to tickle him. On inquiry he told me that Tim had brought the truck, looked over one automatic after the other and had then come to him and said: "Would yez moind tellin' me how yez git th' seeds out o' thim bins?"

Grinding Milling Cutters on the Lathe

By Arthur F. Kunze

While extensive grinding operations upon the lathe cannot be generally recommended, some are necessary and other-

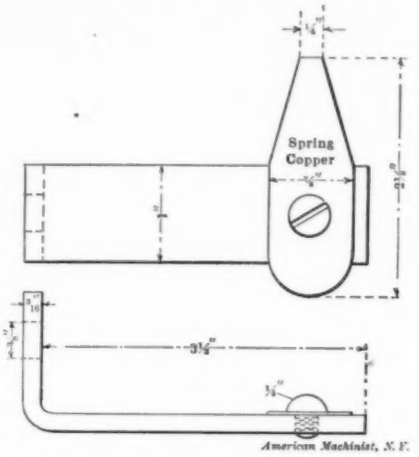


FIG. 1. BRACKET AND TOOTH STOP FOR CUTTER GRINDING ON THE LATHE.

may effect saving far outweighing any loss due to depreciation of the machine used. Many shops using milling cutters, end mills, etc., are not equipped with a cutter grinder, making it necessary to send out the cutters to be ground; besides the fancy prices usually charged for this work, it often causes undesirable delay, especially when a "hurry job" is to be done.

While presenting nothing new in principle the following description may disclose some novel features in the appliances especially designed and used to grind the most used milling cutters of the shop upon the ordinary lathe. Besides the special tools, described in order, a small center grinder taking a 5-inch wheel at 4000 revolutions per minute, such as is usually found in the equipment of most shops is essential.

Grinding Small Mills

Straight-fluted right- and left-hand mills, with straight or taper shanks, ranging in size from ¼ to ½ inch are put on centers and the small angle bracket shown in Fig. 1 screwed to the drive plate of the lathe. An adjustable spring-copper stop is provided on the end of this bracket, supporting the edge being ground. Clearance is given the cutter by turning the lathe spindle slightly forward or backward as the case may require. These small mills, usually plain on the ends, require no grinding there.

For spiral mills of the above description the device shown in Fig. 2 is used. Shell *C* fits the taper in the lathe spindle. *B* is a guide socket which is an easy sliding fit in shell *C*. The screw *A* extending through *B* acts as a draw rod and holds

a special collet required for grinding these mills, as well as screw-shank mills.

An Adjustable Rest

An adjustable rest required for a number of these grinding operations is shown in Fig. 3. It must be borne in mind that this device had to be made at a minimum of cost, and while not above criticism was found to work very nicely. It has a vertical post with screw and nut at the bottom, for vertical adjustment. This allows for giving the mill the proper clearance. After adjustment is made the post is set securely by a set screw at the side. Cross adjustment for grinding work from 0 to 8 inches in diameter is provided through the cross bar *A*, as shown in Fig. 3.

For grinding screw-shank, T-slot and other similar cutters, the device shown in Fig. 2 is put into the lathe and the attachment, Fig. 3, clamped in position. The mill is held in position in *B* by the draw-in rod, the stop adjusted to give the proper clearance and the guide socket *B* moved back and forth with the spiral edge to be ground following over the stop.

T-slot mills are held in this device, but the lathe carriage with the grinder is moved while the mill is at rest with the edge being ground resting upon the stop.

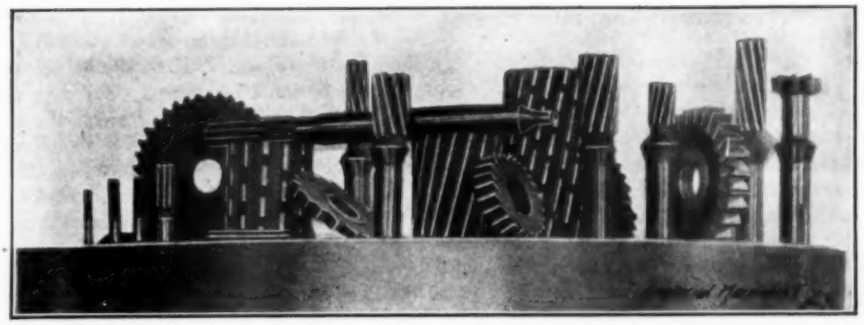


FIG. 5. CUTTERS GROUND IN THE LATHE

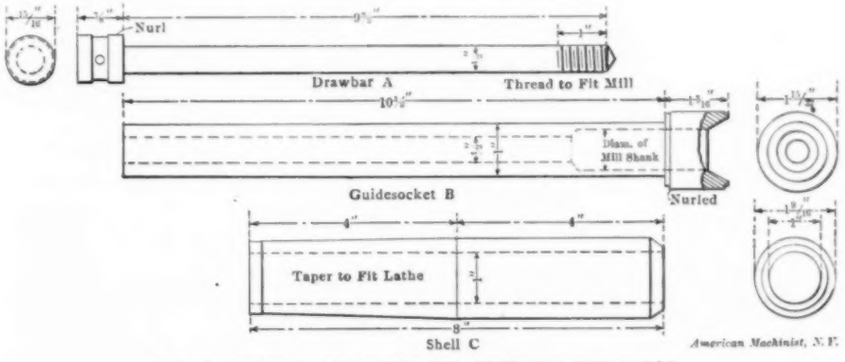


FIG. 2. SPECIAL APPLIANCE FOR GRINDING END MILLS

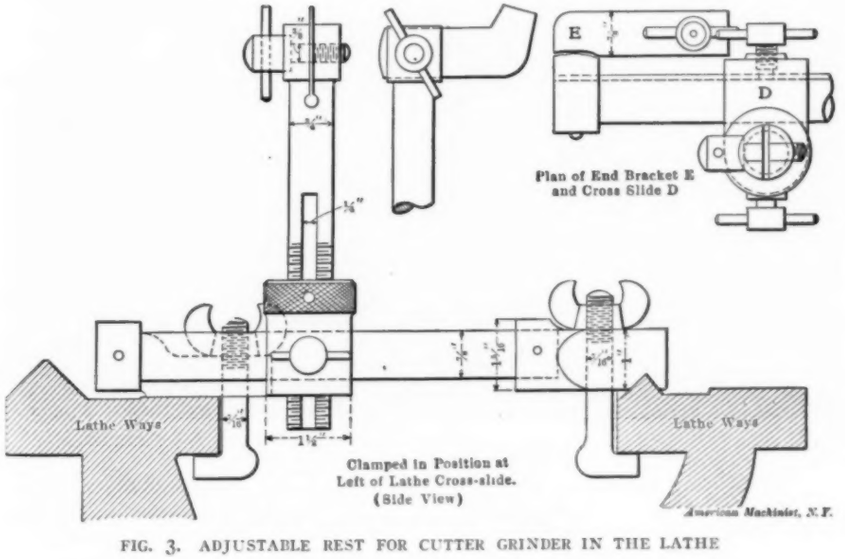

E
D
Plan of End Bracket E and Cross Slide D
Lathe Ways
Lathe Ways
Clamped in Position at Left of Lathe Cross-slide. (Side View)
American Machinist, N.Y.

FIG. 3. ADJUSTABLE REST FOR CUTTER GRINDER IN THE LATHE

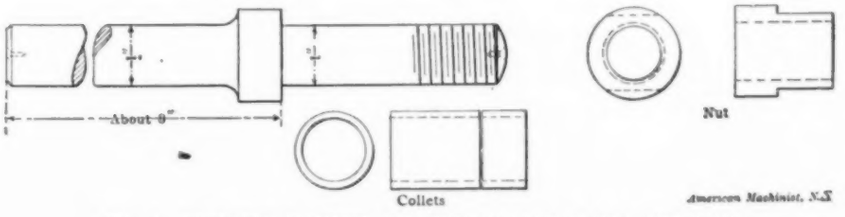


FIG. 4. SHOULDER MANDREL FOR GRINDING SIDE MILLS AND SAWS

Small straight- and taper-shank spiral mills are ground like screw shank except that special collets must be used, as already mentioned.

Handling Face Mills

Face mills up to 6 or 8 inches in length, and inserted-blade mills with straight or spiral flutes are put upon a mandrel which is held on the centers. The cutter must be an easy sliding fit as the grinder in this case is stationary while the mill is moved with the left hand, giving it a gentle forward pressure, the spiral flute thus moving over the stop, directly in front of which the emery wheel revolves.

Side mills and saws, by reason of the fact that they are too thin to have sufficient bearing surface to slide upon a mandrel, are screwed upon a shoulder mandrel shown in Fig. 4. This mandrel is carried upon the lathe centers, the stops adjusted under the tooth to be ground and the carriage of the lathe moved back and forth by the hand wheel. In this case again the tool to be ground is stationary while the lathe carriage moves. The flutes or teeth in this case must be straight as they usually are in narrow cutters and saws.

Angle Mills and Reamers

Angle mills of 40 and 60 degrees were also ground as well as side edges of side mills; this is done by setting the cross slide to the proper angle and using the cross-slide screw. This method, or rather the grinding of this class of work, was found cumbersome and is not recommended here. Reamers, both straight and taper, may also be ground by using the device in Fig. 3.

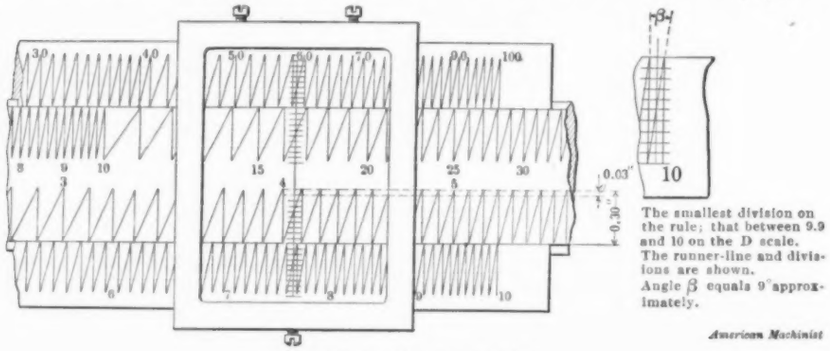
The half-tone, Fig. 5, shows a number of cutters ground with these appliances which have been in use for some time and have effected a saving of from 25 to 50 per cent., besides affording the convenience of grinding up a cutter at short notice right in the shop.

I freely admit that all cutters should be ground on a grinder, that it would not be advisable to attempt to grind odd-shaped cutters; in the absence of a grinder, however, this method of grinding the ordinary cutters of the shop will be found convenient and inexpensive.

A Precision Slide Rule*

By A. N. Lurie

The Mannheim slide rule, as arranged fifty or sixty years ago by Col. Mannheim of the Austrian Engineer corps, has served the engineer and scientist for half a century, as an invaluable instrument. The facility with which it may be operated, its value as a saver of time and of mental and manual labor, if pushing a pencil may be dignified by the term *manual labor*, has won this tool a place in the kit of every progressive engineer. The item, however, which has probably made it of greater value to the engineer than to the scientist, is that in the great majority of those problems which occur in engineering practice its accuracy is sufficient.



A PRECISION SLIDE RULE

The engineer in general understands that without going to any great pains the error in any reading can be kept as low as 1 per cent., that is, the first doubtful figure, varying by one, plus or minus, is the third significant digit. To repeat, this degree of accuracy is sufficient, for in general engineering calculations we do not measure the inside diameters of our stacks with micrometers, nor a carload of coal in milligrams—inches and hundred weights will do.

But to say that this degree of accuracy, illustrated figuratively, is sufficient for most engineering work, does not indicate that it will pass for all. In the bridge shop, the templet maker has no use for a dimension which reads 8 feet 1.2 inches about. He must have the dimensions accurate to within a sixteenth of an inch, so that the chords, struts and other members may go together out in the field. In laying out a connecting rod, we do not say that the distance, center to center, of brasses is 5 feet 2.7 inches about, implying that it may be 5 feet 2.6 inches or perhaps 5 feet 2.8 inches. The distance is either 5 feet 2.7 inches exactly, or 5 feet 2¾ inches, or, whatever the case may be.

With the idea in mind of increasing the accuracy of the slide rule, and at the same time of avoiding an involved instrument, the writer stumbled upon a device which he believes will make a more accurate and desirable tool. The accompanying drawing shows a full size layout of the middle portion of the scales. The fundamental principle is not a new one by any means, and is used in some forms of physical and engineering manometers, as for example, in the inclined-tube draft gage. In this slide rule, it consists substantially of lengthening the graduations several hundred per cent., without increasing the length of the rule. A perpendicular to the longitudinal center line is erected at each major division, a major division being, for example, the distance between 5.1 and 5.2. A series of perpendiculars, all of the same length, is formed and lines are drawn from that extremity of each perpendicular farthest from the slide to the foot of the next one. These lines, the hypotenuses of a series of right triangles whose bases are the logarithmic divisions, and whose altitudes a given distance, now become our scale proper. Horizontal graduations on the runner-glass which are intersected at right angles by the hair line divide the perpendiculars, and, of course, at the same time the hypotenuses into ten equal divisions.

In the rule wherein the distance between indices is 25 cm., known commercially as the "ten-inch rule," the increase in scale length in *C* and *D* or lower scales will be a little over 200 per cent., while in the upper, or *A* and *B* scales it will probably reach as much as 300 per cent. or more. The length of the perpendiculars is three tenths of an inch, making each division on the runner glass 3/100 of an inch or about 1/32. This makes the rule easy to read. The smallest angle which occurs between the hair line and any hypotenuse is that on the *C* and *D* scales, between the divisions 9.9 and 10. This angle is 9 degrees. The runner glass is very thin and close to the scales, so as to avoid parallax as much as possible. It is adjusted by four small set screws, two above and two below. The operation of this rule and the Mannheim are identical.

The accuracy is increased from one in a hundred to one in a thousand. This instrument is easier to construct than the Mannheim, as it reduces the number of lines in the scale from 1284 to 820, or a reduction of nearly 36 per cent. Thus we have a simpler and at the same time more accurate instrument.

*Condensed from *The Technograph*.

Boring Methods Used in Gasolene Engine Work

The manufacture of gasolene engines involves considerable boring of one kind and another, and usually develops some interesting methods and appliances. Through the courtesy of Superintendent Blair, of Buffalo Gasolene Engine Company, Buffalo, N. Y., we are able to show a few of their methods which have novel points about them.

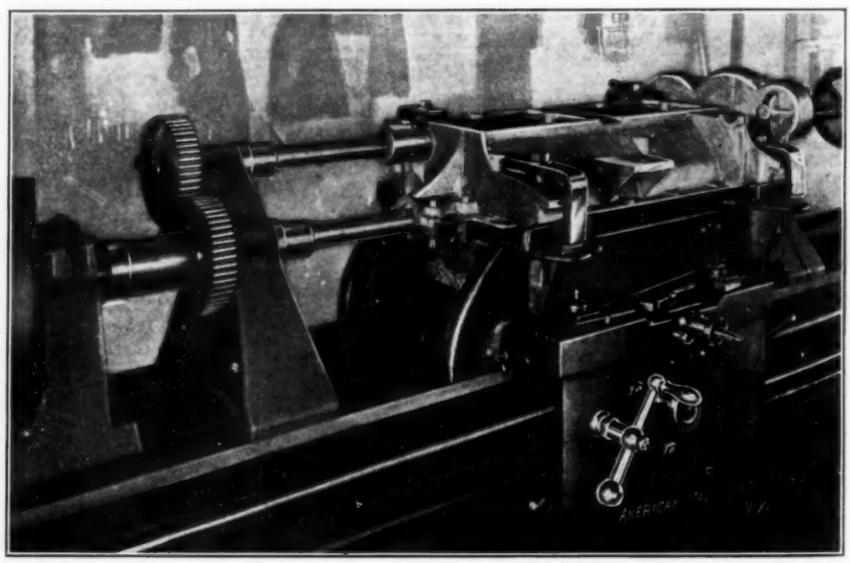


FIG. 1. BORING ENGINE BOSSES ON A LATHE

In Fig. 1 is shown an interesting fixture for converting an engine lathe into a horizontal boring machine by a somewhat unusual procedure. Instead of bolting the fixture to the lathe carriage, as is usually done, Mr. Blair made the fixture long enough to span the carriage, and bear on

the ways of the lathe bed at each end of it, as well as rests on the carriage itself. This distributes the load over a much larger area and insures greater stability for the fixture and the engine base which is to be bored.

In order to run two boring bars at the same time, a support is placed across the lathe bed in front of the head and an extended spindle, carrying a spur gear and also bored to receive the lower bar, is firmly supported in this way. This also carries the shaft which drives the upper boring bar as can readily be seen. In addition to the methods shown of supporting the engine base while it is being bored, there are intermediate supports for the boring bar between the crank-shaft bearing in the crank pin. This insures a rigidly supported boring bar and makes the alinement of both the crank-shaft and cam-shaft bearings about all that can be desired. Single-point cutters of high-speed steel are used. After the pistons are turned the wristpin holes are not drilled in a jig, as is quite common, but are all bored in lathes, as can be seen in Fig. 2. These fixtures are screwed onto the lathe spindle, and the bore which receives the piston is very accurately located so as to bring the wristpin holes exactly in the center of the piston with regard to its

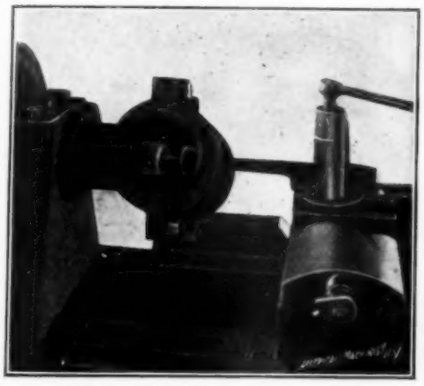


FIG. 2. BORING OUT WRISTPIN HOLES

diameter. These are quickly put in place, and clamped, by the bolt shown, a roughing drill first going through the holes. The bore is then trued up with the lathe tool shown, and the hole finished by reaming between centers, which, although it takes a little longer than when done under a drill press, seems to give more satisfactory results in this case.

Making Piston Rings

The method of making piston rings in this shop is somewhat unusual, but has proved very satisfactory. They are cast in a cylinder or pot having four lugs which bolt to the faceplate of the Jones & Lamson lathe while they are turned on the outside and faced on the end. The tools are arranged so that the roughing cut is taken by one tool on the forward movement of the carriage and the finishing cut by tool on the opposite side on the return travel. Stops in both cases allow very accurate turning to be done in this way.

They are then bored on the boring machine shown in Fig. 3, the angle plate shown being the same as is used for boring cylinders, but for this work it carries the additional plate shown in front which holds the piston-ring castings. These are prevented from turning under the action of the boring tools by one of the lugs going against the strap shown at the upper right-hand corner. They can be bored either eccentric or concentric according to their location with reference to the boring bars and two castings can be bored at the same time the same as with the cylinders.

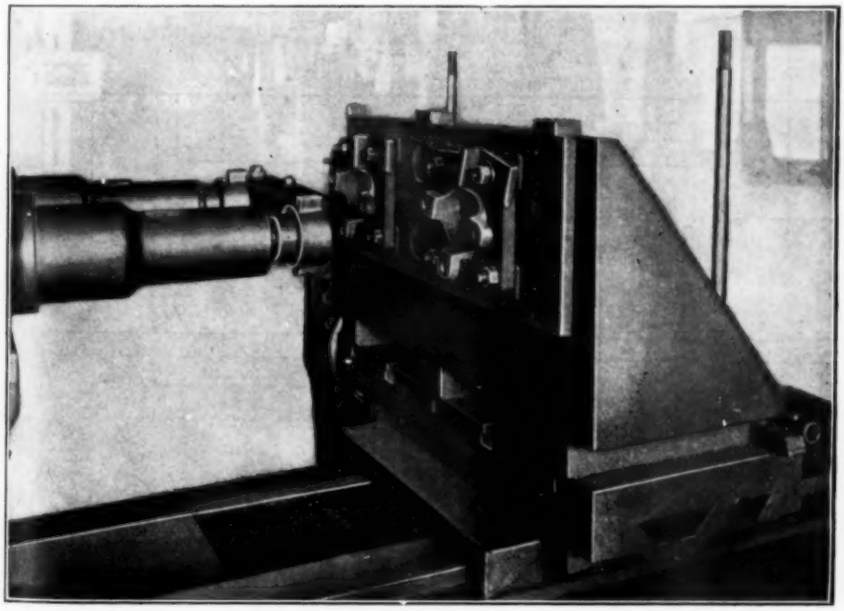


FIG. 3. BORING OUT PISTON RINGS

Fig. 4 shows a group of the boring heads which consist of a cast-iron bar carrying a steel cutter head as can be seen from the tool shown in the foreground. These are made both with two and four cutters, as can be seen on the larger bar. The cutters are clamped by the four fillister-head screws and adjusted for diameter by the cone bushing in the center being moved in or out against the back ends of the cutters which have the same angles as the cone.

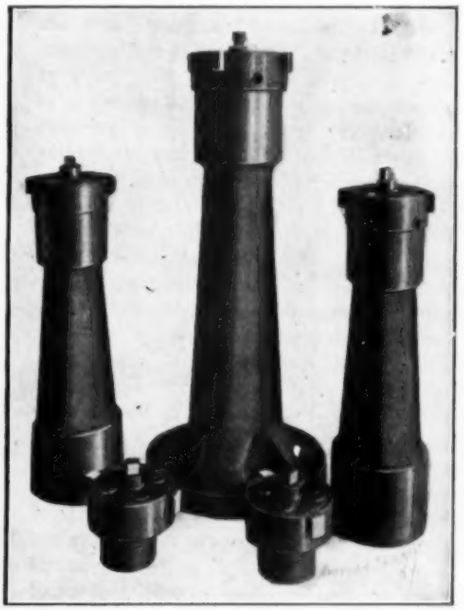


FIG. 4. THE BORING BARS AND HEADS

As it is frequently desired to ascertain whether a specimen is wrought iron or steel, a simple test, given by the *Brass World*, will serve to indicate it. The sample to be tested is cleaned from grease and scale by scouring and then immersed in a solution composed of the following: Water, 9 parts; sulphuric acid, 3 parts; muriatic acid, 1 part. The acids are poured into the water and allowed to cool. A glass or porcelain vessel is used. The specimen is allowed to remain in the solution for 15 or 20 minutes, when it is removed, rinsed in water and dried with a cloth. The fibers will now show plainly; but if not, it is returned and allowed to remain longer. As iron is made up of a series of fibers, interspersed between which is the slag, it is a simple matter to distinguish it. Soft steel dissolves uniformly and without the fibrous structure found in wrought iron.

The best flux for use in melting aluminum, alloyed with zinc or copper, is chloride of zinc. A small piece is thrown on the metal when melted and serves to clean the surface. According to the *Brass World*, the test of time has proved it to be the most satisfactory flux for the purpose.

Some Large Sectional Punches and Dies

How Special Press Tools for Blanking Close Work Are Built up in Sections to Facilitate Construction and Insure Accuracy of Product

EDITORIAL CORRESPONDENCE

The Nestor Manufacturing Company, 40 West Thirteenth street, New York City, is engaged in the production of special machines and tools of various kinds such as punches, dies, etc. A number of large, sectional press tools have recently been completed by this company, and the accompanying engravings illustrate the principal features of some of these punches and dies.

Press Tools for a Toothed Blank

Fig. 1 illustrates a steel blank, approximately 8¾ inches long by 1 inch wide, having a series of teeth which are provided with rounded ends, and filleted bases, and are accurately spaced from end to end, there being 46 teeth in the complete piece. This piece is a key-bar spring support for use on a typewriter, and in appearance is quite like a coarse-tooth comb. The press tools in which it is manufactured are illustrated in Figs. 2 and 3. The principal dimensions of these tools are given in the drawing and, as there shown, they are fitted with four guide posts or corner pins so that the tools are really of the subpress type. The upper member of the combination is marked *A* and the lower member *B*. In each case there are six die blocks *C C C* and *D D D* fastened by screws and dowels to the cast-iron main block, these parts being made in short sections to insure accuracy and prevent distortion during the hardening process. An examination of the drawing, Fig. 2, and the sectional sketch, Fig. 3, will show that each block *C C C* and *D D D* is provided at one end with a series of teeth of the correct form and pitch, and as shown in the sketch, Fig. 3, the teeth on blocks *C* of the upper member simply shear past the teeth on blocks *D* of the lower die. Between the teeth of the two sets of blocks *C* and *D* fit corresponding teeth on shedder plates *E* and *F*. Each of these shedders is backed up by seven coiled springs made of 3/16-inch square steel wound 1 inch outside diameter. The shedders are of heavy section, which, with the stiff springs used insure the work being removed from the dies without being sprung out of shape.

The blank is cut approximately to length and width and is pierced at each end in a preliminary operation so that it may be dropped over the locating pins shown in dies *D*. In this position it rests against a long backing strip which, as noted on the drawing, prevents the stock from springing away at the center during the tooth-blanking operation.

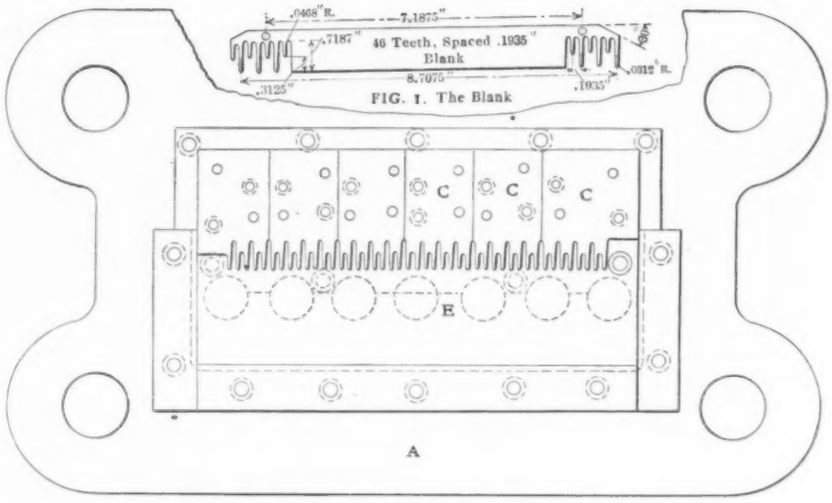


FIG. 1. The Blank

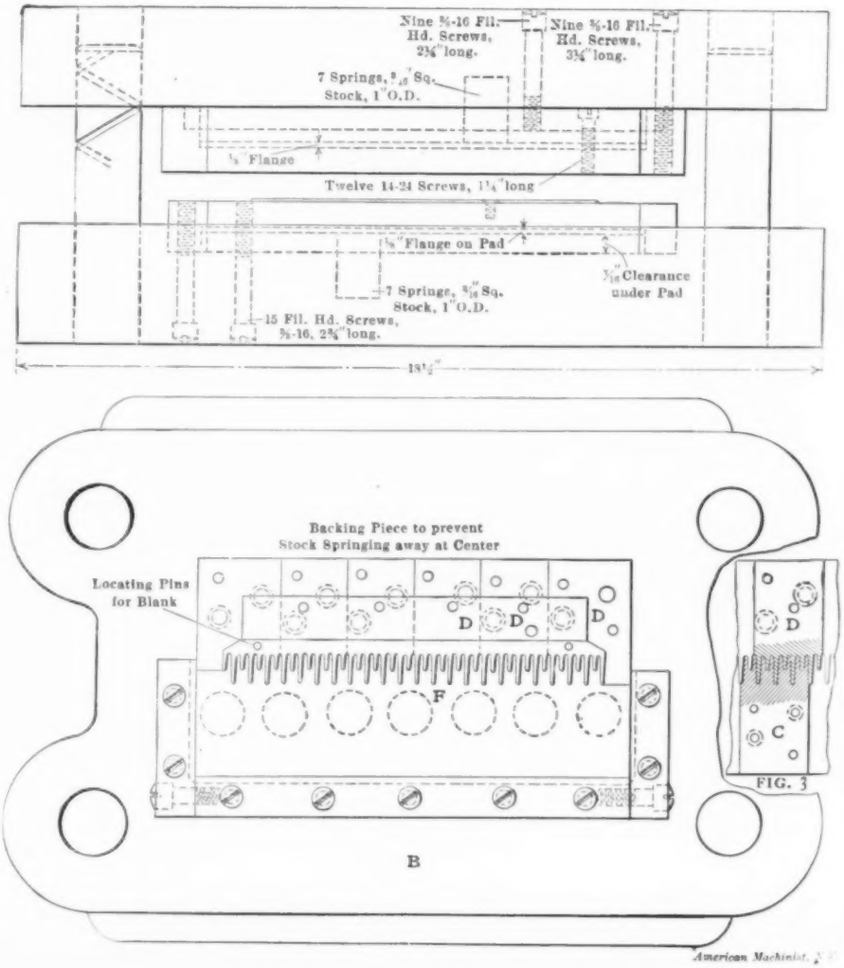


FIG. 2. SECTIONAL PRESS TOOLS FOR A TOOTHED BLANK

FIG. 3

In cutting the teeth in the die blocks *C* and *D*, a form tool was used in the shaper, and the correct spacing from tooth to tooth obtained by means of a micrometer dial on the cross-feed screw for the saddle. A portion of this screw long enough to give the total cross movement required was tested in connection with the micrometer dial to insure the blocks being accurately spaced and then with the grooving tool fed down to the work it was a comparatively simple matter to secure the accuracy required, although, of course, care had to be taken in the vertical feeding operations to prevent springing of the tools, and tearing of the work.

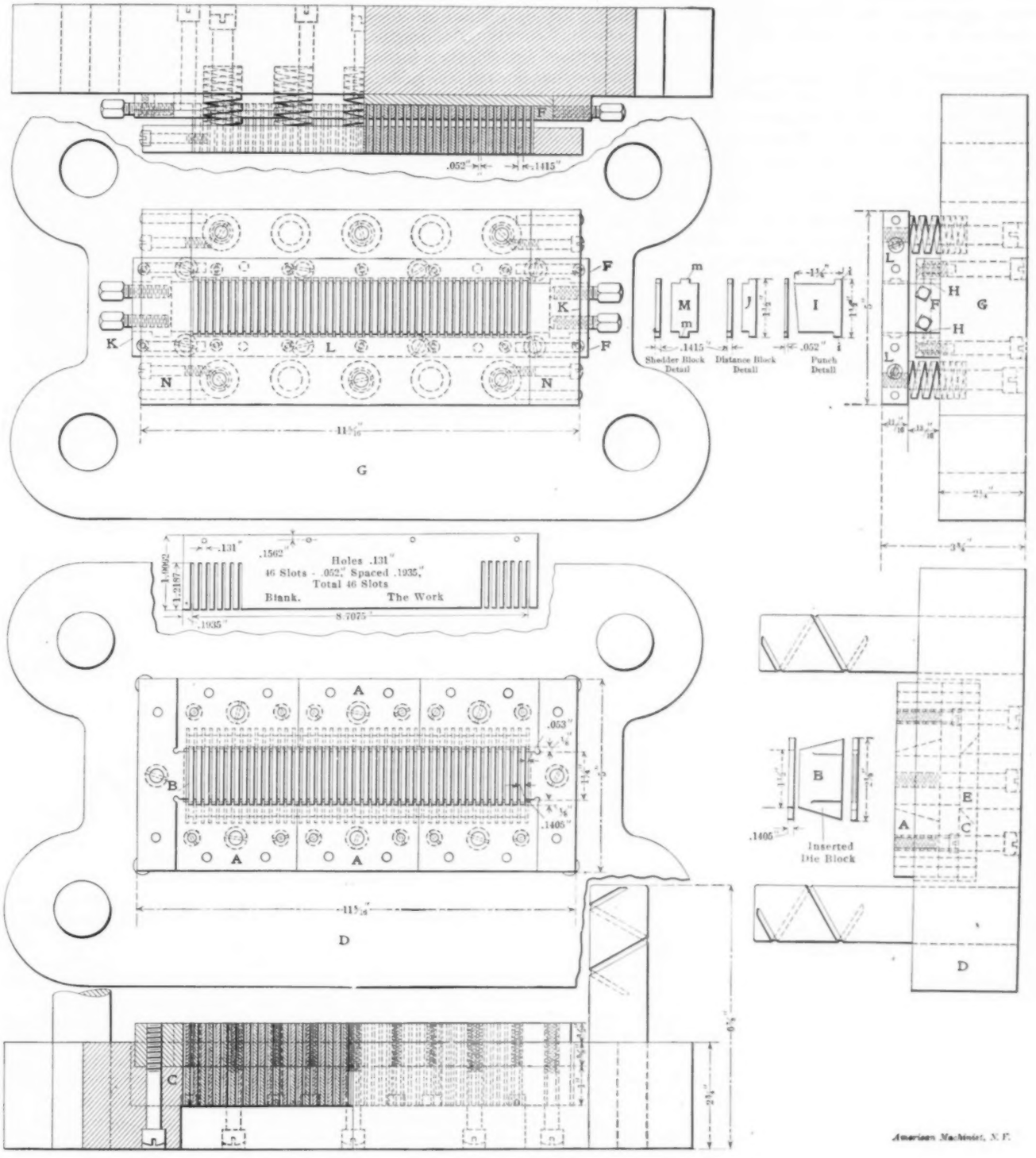


FIG. 4. SECTIONAL PUNCH AND DIE FOR A STRAIGHT TOOTH BLANK

TOOLS FOR A STRAIGHT TOOTH BLANK

The punch and die shown in Fig. 4 are for producing the straight tooth blank shown near the middle of the drawing. Both punch and die are shown in plan, elevation and partial section, making their construction quite clear, although there are a number of interesting features to which special attention should be called. Like the sectional tools in Fig. 2, this punch and die are also of the sub-press type.

The die in this set of tools for punching the series of 46 straight slots in the work consists of six blocks *A*, 1⅛ inches thick, having a series of notches milled out on the facing edges to receive the bevel-end inserted members *B* which form the series

of partitions between the opposite sets of holding blocks and provide the cutting edges past which the punches shear in cutting out the slits in the blank. The main holding blocks *A* being made in three sections, are accurately gashed and then hardened without distortion so that when assembled the narrow inserted blocks will be correctly spaced from end to end of the die.

These narrow blocks, as will be noticed from the end view, are inserted from the under side of the die blocks proper and rest solidly upon the heavy block *C* which in turn is carried in the seat milled out in casting *D*. The openings in block *C* which permit the narrow scrap punchings to fall through are formed by sinking in a saw from the bottom, making the cut indicated in the end elevation at *E*, and then finishing the opening from this curved cut straight up through the block, as shown by dotted lines at *E*. Both sides of the inserted members *B* are relieved from the bottom, as indicated in the detailed sketch, to a point about 3/8 inch from the cutting edges. This relief is clearly shown in the bottom view of the piece at *B*.

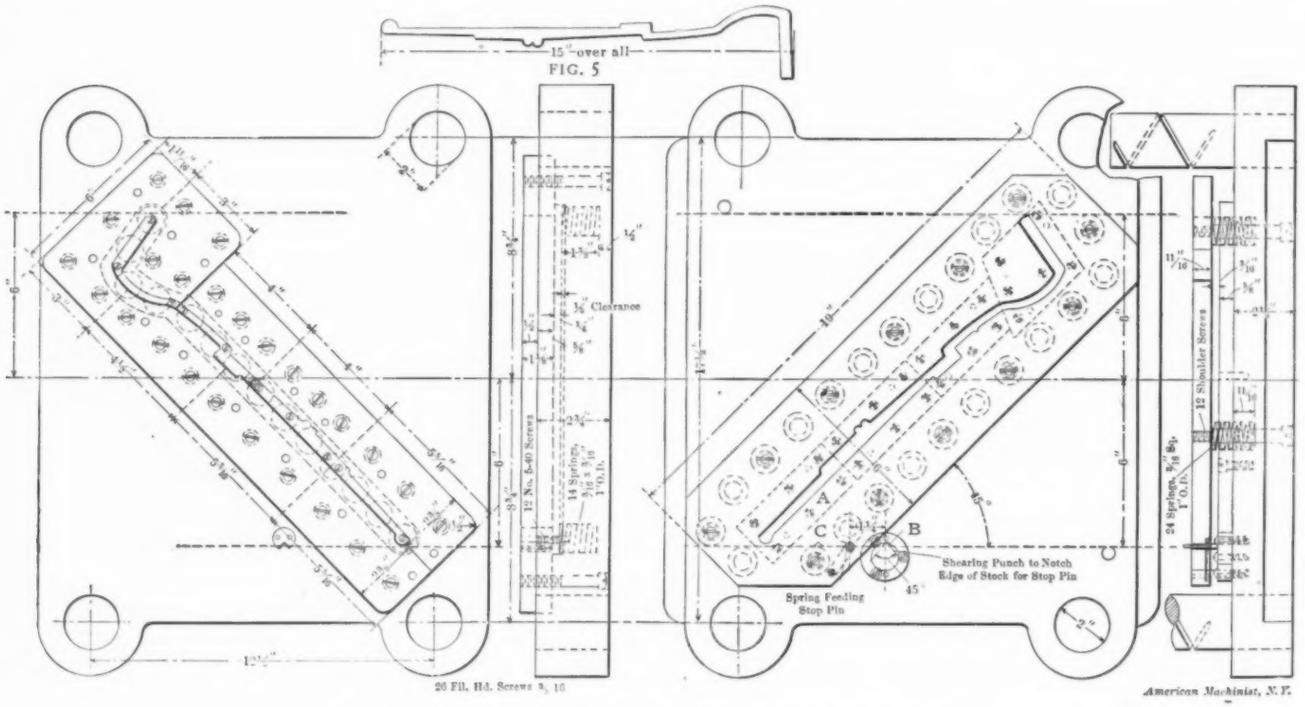


FIG. 6. SECTIONAL PUNCH AND DIE FOR A LONG, NARROW BLANK

How the Sectional Punch is Built Up

The punch holder *F* consists of a pair of long steel blocks attached to casting *G*, each of which blocks has in its inner face a longitudinal groove planed from end to end, as indicated at *H H*, to receive the suspending lugs or ears *i* at the back of punches *I* and distance blocks or packing blocks *J*, one of which is interposed between each pair of punches to space them the correct distance apart throughout the length of punch holder. With the 46 punches and the intermediate packing blocks put in place in the strips *F F*, and the two end blocks *K K* attached as shown, the series of inserted blades and blocks are then clamped up tight by the set screws tapped through blocks *K K*. The punch block as thus built up is firmly attached to base *G* by a series of fillister-head screws and dowels. The punches *I*, it will be noticed, are sloped at the ends to give a shearing cut, and are guided to prevent springing, between spacing blocks mounted in the stripper plate *L*. One of these blocks is shown in detail at *M*, and the position of the series of blocks in the stripper is brought out clearly by the plan view.

Stripper *L* is also built up of two rectangular blocks grooved lengthwise along the inner faces and gashed crosswise to determine the lateral position of the spacing blocks *M*. These spacing blocks are supported in the stripper by lugs *m* at either end which enter the longitudinal grooves in *L L* and they are, of course, spaced the right distance apart by the series of vertical gashes just referred to. Blocks *N N* at the ends of the stripper are secured by screws and dowels to the main members of the stripper *L L*, and prevent the latter from becoming distorted in action.

All parts of the punch and die illustrated are made with great accuracy, and it will be obvious upon inspection of the drawings that the punches are well supported while in actual contact with the work, and as they take a shearing cut in removing the stock between the teeth, the cutting action is free and a very satisfactory job is produced.

Sectional Tools for an Awkward Piece

Fig. 5 is a special lever made of sheet stock and is of peculiar shape and proportions. The press tools for this piece are illustrated by Fig. 6. Both punch and die are built up with a number of sections so divided as to facilitate construction and enabling distortion in hardening to be obviated. All members are securely fastened to the cast-iron base blocks by means of fillister-head screws and dowels. Each punch section as at *A* is of T-section, the punch proper being formed on a base of sufficient width to allow a row of screws and the necessary dowel pins to be placed along either edge. The punch and die are placed diagonally across the main blocks, thus blanking the work obliquely to the edge of the stock when passed through and so economizing in the material, this arrangement allowing the pieces to be punched out with very little scrap stock between consecutive blanks.

Upon referring to the plan view of the punch, a V-shaped shearing punch will be noticed at *B*, which, as marked upon the drawing, is used to notch the edge of the stock so that at the next feeding stroke this notch will be engaged by the spring stop pin *C* and the stock correctly located for the cutting out of the next blank.

A compound of 6 parts lard and 1 part rosin is given by the *Brass World* as an efficient protection for polished steel work from rust. The two ingredients are melted together and stirred until cold. The rosin prevents the mass from becoming rancid and also acts as an air-tight film. If rubbed upon a polished steel surface it effectually preserves and protects the polish.

The Social Side of Industrial Education

By E. H. Fish

Mr. Kreuzpointer's article by no means exhausts the subject. The social aspect may possibly outweigh all other considerations, and yet on the other hand we may possibly find that society in its process of evolution may be our greatest aid.

But little has been said of the work done a year ago last summer in Worcester, by the old Massachusetts Commission on Industrial Education. That commission undertook to show to the people of Worcester just how they stood on the subject, but the full results were never published. I was so fortunate as to have charge of the work, and consequently feel that I am in an excellent position to correctly estimate how freely social ties will enter into our Worcester problem.

To explain what follows I should say that we went about the city on what proved to be an educational work, canvassing the parents of children who were then in the 6th, 7th, 8th and 9th grades and who were over 12 years of age. We did inquire about a few below that age but gave it up since most parents had not given the future of such young boys serious thought. We explained in as few words as possible what we aimed to do. That is that we wished to establish a free public school, entirely independent of the old system, in which there should be taught the trades most commonly practised in Worcester, the students' time being given, one-half to the practice of their trade, the other half to the pursuit of "book learning." We wanted to know whether the parent seen favored the proposition in general, and then whether he would send his child if the school was started.

The proposition took like hot cakes. I first started work in Greendale among a class of thrifty Swedes. I expected to have good fortune there, possibly finding children at one place in ten. When I summed up my first day's work and found that fully a third of the children whose fathers or mothers I had seen, would be sent, I hardly knew what to think.

I changed localities but found the same results; then I began to paint the proposition less well, thinking that my own interest in the work had been contagious. The results remained about the same. Then I called in special reports from my other canvassers and found that they were all getting higher percentages than I was. Between 80 and 90 per cent. of the parents favored the establishment of the school. Only 4 out of 3700 opposed it. The 3700 families had 2500 children who wished to attend, and about an equal number who did not. Barring out all possible chances that parents answered us favorably to be more easily rid of us, there remains a large number of children whose parents wish them to have this training.

We tried to impress it on everyone, children and all, that this school would mean real work and lots of it, and that there would be but little play about it. How large a proportion of the children themselves would voluntarily attend we do not know, though I believe a large part would try it. The average boy of 12 or 13 thinks very little about the disgrace of having his hands dirty and very little about what someone else's sister would think about him for the same cause. He does think a great deal about the misery of going to school and being bossed by a woman. You can talk shop to him and it appeals to him. Most boys between 12 and 90 like to see the wheels go round; they like to see something being made and they like to see it growing in their own hands. So far does this feeling go that I believe that the whole difference between the success and failure of a school might depend on whether they made "exercises" to be scrapped, or gasolene engines to be started up, tested, and sold!

The readers of the American Machinist being more interested in the boys I will pass over the girls except to say that they were not in the least bashful about admitting that they could find a use for much more knowledge of housekeeping and cooking than they could get at home or in the present public schools.

The boys who appeared to take interest in our proposition were scattered all over the city. The more aristocratic sections had a few more who aimed higher, which was part of our advice to them, but the attitude of contempt for skilled labor was so nearly entirely lacking as to be a great surprise. I went day after day to homes where I expected, before I found how things were going, to be turned down and told that my queries were insults, only to be invited in and plied with questions myself, and they were intelligent questions. In fact I believe that I answered more questions than I asked.

These wealthy people, however, looked upon the proposed school in a different way as compared with their brothers of the east side. They looked at its training as a means to an end. The east side looked on it as an end. The west side saw that a boy who had a trade plus brains could advance beyond the lathe and the bench. They also saw their boy, already at 12 impatient of books alone, to their regret. They hailed this new school with joy as a means of keeping the boy in school, but hoped that its training might open the boys' eyes to the value of an education and prompt them to do their class-room work with spirit. Many boys looked on the school as a compromise. They would go there and study half the time if they could only "make things" the rest of the time.

On the east side it was money no doubt that was the leading factor. To those boys the prospect of some day making $3 a day was as alluring as the prospect of $3000 a year on the west side. Down among the slums, if you can call them slums in Worcester, was the most interesting work. There were children whom no one wanted; ready and anxious to work and earn, but with nothing in their education to help them earn a cent. It did seem as if the State in taking those children away from their parents for the best part of the day for the best part of the year had given them nothing in return. It was like giving a starving man chocolate bon-bons. There was no chance of any psychological effect here, for most of the talking had to be done through interpreters.

An astonishing thing that developed as we went along was that only about one father in six had ever "learned" a trade or a profession. The rest picked it up or broke into it in other ways. Of the machinists one-half served apprenticeships of other skilled workers in metal; not more than 1 in 10 served their time. The men who had trades almost invariably wanted their boys to learn, not necessarily the trade that they were following, but some trade.

Having stated as a fact that very few people in Worcester have any feeling against the dignity of labor, I wish to review a few things that Mr. Kreuzpointer calls to our attention.

The Study of Latin

In Worcester this is on the decline, and would be still further eliminated from the high-school courses if our educated people could have their way. The great demand for the dead language comes, as he suggests, from those who are on their way up the social ladder, and who see something mysterious in it. We have not a very large number of social climbers.

Hero Worship

Mr. Kreuzpointer is undoubtedly right in saying that hero worship as taught in our schools is a mistake, but I imagine that its influence is not so bad as he intimates. The worst hero worship that we have is not taught in the schools but on the streets and in the corner groceries, where our little ward politicians grow to be giants in the minds of the boys. The same wonder as to "how they get a living" that bothers us older people comes to the boys, and too many of them rush into politics to find out. I am inclined to think that the hero worship in the schools is vague and indefinite enough so that in the general haze that surrounds the pupils and befogs their minds, they do not get a very distinct notion about it.

Vocational Education

I shall have to confess that I have that common-school haziness about what vocational education means, but whatever it is I am against it. I fail to see any demand for

any half-way measures. If the name was taken as a blind to mislead the laboring men in the unions, I should say that it would be best to drop it. If it means trade training I prefer to say "trade." What is very distinctly felt all over Worcester is that manual training is a farce and that trade training should be careful and complete training in a trade. No six months' courses in machine work will be tolerated. A thorough course approximating the regular shop apprenticeship with sufficient school-room work to prevent stagnation during the most recipient years is what is demanded in no uncertain tone.

One other thing our work showed and that is that it is futile for any manufacturer to attempt to reach many of the very best boys. There is a deep-seated feeling of distrust against shop foremen and superintendents. People feel that while the head of a firm may believe in this work, he does not know enough of what is going on in his own works, so that he can control the actions of his subordinates. It is not at all to be wondered at after all the years in which an apprentice has been considered a thing to be kicked and cuffed about the shop picking up a little something if he could, but never to be taught a thing except to be kept at it months after he had learned it.

There is no doubt in my mind but that the education of machinists belongs to the machine shops; but if they will not, or if they cannot, I do not believe that our younger generation should be made to suffer for it. As we are trying in Worcester to solve the problem, we feel that it is very little different in effect from shop apprenticeship under ideal conditions. We propose to have a real shop doing real work taken from the local shops, under men from these same shops, but men whom we have selected for their expected ability to show others how to do things. These men's duty will be primarily to teach the boys to do things well; secondarily to teach them to do things quickly, in a shop way.

The investigations of preservative treatment of timber have become so important that the Government has established in the Forest Service a bureau of wood preservation with headquarters at Madison, Wis. This bureau will give its entire attention to the prosecution of experiments in wood preservation in coöperation with railway companies and others interested in prolonging the life of railroad ties, bridge timbers, mine props, fence and transmission poles, etc. It is estimated that wood decay in this country amounts to from 20 to 40 millions of dollars per year, and progressive and efficient methods of preserving wood can undoubtedly be made to reduce materially such a large national waste. This particular work is expected to prove of large importance in the program of conserving our natural resources in which the public has become awakened.

Electric Welder for Machine Shops and Foundries

By R. F. Williams

Owing to the extensive use to which steel castings are being put in the construction of modern machines, and the difficulty in obtaining good, sound castings, any apparatus that will rectify these troubles should be a boon to the foundry or machine shop. Furthermore, when it is understood that it is possible to actually build up any of the parts of a machine made of steel, whether it be steel castings or machinery steel, or even wrought-iron forgings, the advantage of such an installation in any shop will be at once apparent.

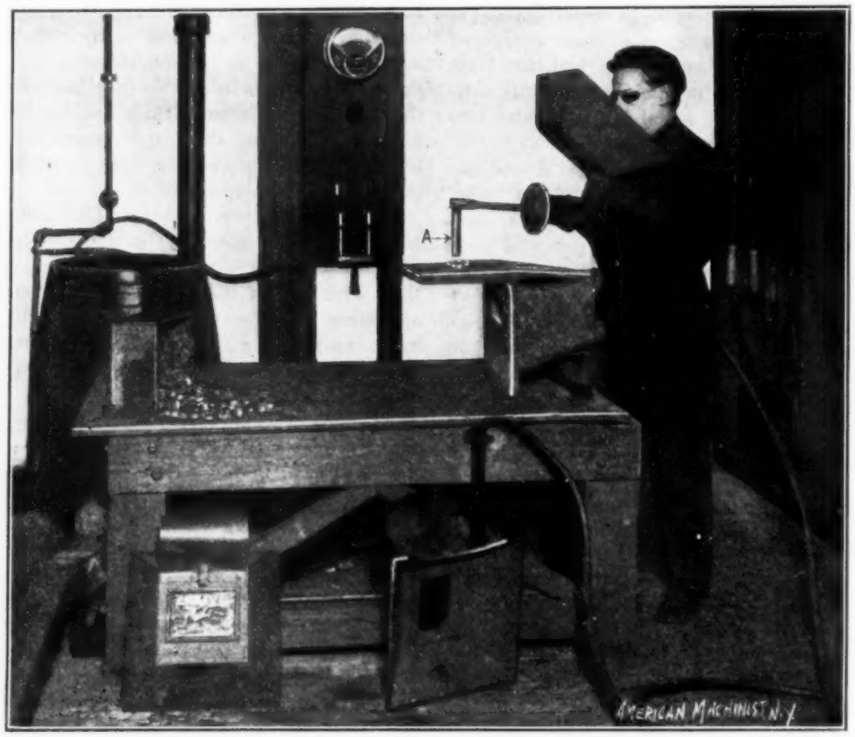


FIG. 1. HOMEMADE ELECTRIC WELDER

A great deal of work, which under ordinary conditions would be spoiled and consigned to the scrap pile, can by the use of an electric welder, be made as good as new and the weld impossible to detect. For example, take a steel-wheel center that has been turned down too small, due to a mistake by the machinist or otherwise, by melting material and building up the casting, as will be described later, the diameter can be increased as much as desired. The wheel center is then put on the wheel lathe again and machined to its proper diameter. The effect of the electric welding does not harden the steel as would naturally be expected, and the union of the metals cannot be distinguished. After coming from the welder, the weld has a rough, lumpy appearance, which can be easily chipped or machined.

A very simple homemade electric welder, as shown in Fig. 1, can be installed very cheaply, with materials which can be picked up in almost any industrial plant; the only essential requisite being a supply of direct current at 110 volts.

The apparatus consists of a heavy bench, covered with ¾-inch boiler plate. To the boiler plate is connected the negative pole of a 110-volt circuit. The positive pole after passing through a water rheostat, is carried to a handle ending in a carbon tip *A*. By placing the article to be operated upon on the boiler plate, it of course will make its own electrical contact with the plate, and when the carbon point is brought in contact with it, practically a closed circuit is made through the water rheostat. By drawing away the carbon point, an arc is formed similar to that formed in an arc lamp, the arc going from the carbon point to the steel casting. This arrangement should be observed carefully, as, if the current flows the other way, i.e., from the steel to the carbon tip, the apparatus will not work.

The arc is allowed to play around the point on the casting, where the welding is to be done until it gets red hot. This will only take a short time as the heat of the arc is so great that apparently very little heat is conducted away by the mass of metal around it. When this has been accomplished, boiler-plate punchings or other bits of steel are placed alongside the hole which is being filled, and the

arc allowed to play on them. They will immediately melt and run down into the hole. The arc is then made to play on this material in the blowhole until it melts into and forms a part of the main casting. This operation is continued until the hole is built up even with the rest of the casting. Care should be taken that the holes are cleaned, before starting to weld, of any sand or other foreign material.

The water rheostat is simply a barrel filled with water in which are placed two pieces of boiler plate; one at the bottom, which is stationary, and the other, a movable one above it. It can be raised and lowered by means of a weight and cord passing over a pulley. By this means the resistance is varied until the best results are obtained.

The apparatus works best when the resistance is adjusted so that between 150 and 250 amperes are flowing through the circuit. It is necessary to add about a pail of salt to the water in order to increase its conductivity. By starting with the movable plate at the top of the barrel, and lowering it gradually, no trouble will be experienced with circuit breakers blowing out, etc. This rheostat will have to be adjusted again after the water heats up.

In using this device a little care must be exercised as the rays given off by the arc which is formed have the effect of sunburn. Unless the hands and arms are protected by gloves and the face protected by a shield, a bad burning will result.

I stood 20 feet away from this while it was in operation, without a shield, for about five minutes and got a bad case of sunburn, with the accompanying symptoms of skin peeling, etc. The shield is made of wood ¼ inch thick with an opening containing two thicknesses of ruby glass through which the operator looks at the work. An improvement of the shield shown has been developed, which consists in strapping the shield to the operator's head, allowing both hands to be free for work.

The handle, a sketch of which is shown in Fig. 2, consists of a light ¾-inch brass tube on which is screwed a brass casting for clamping the carbon point. The carbons used are 1 inch in diameter, and can be obtained from any electrical company. About 8 inches long will be found right, then as it burns away it can be adjusted to suit. The casting for clamping the carbon should be split to allow for this, also for tightening it to make a good electrical contact with the carbon. Care should be taken to make very good electrical contacts on all parts of the handle, as when the current is flowing (150 — 250 amperes), it will very quickly heat up to the discomfiture of the operator. A wooden handle is slipped over the brass tube and a very flexible copper cable is soldered at the end and forced into the brass tube, a set screw holding it firmly in place. Unless a very flexible cable is used, it will be found very tiring on the operator's arm to hold this out as shown, for any great length of time. A round piece of fiber provides additional protection to the hands from the electric rays.

While this installation is shown with circuit breakers, ammeter, switch, etc., these can all be omitted and a switch only used, thus simplifying the installation.

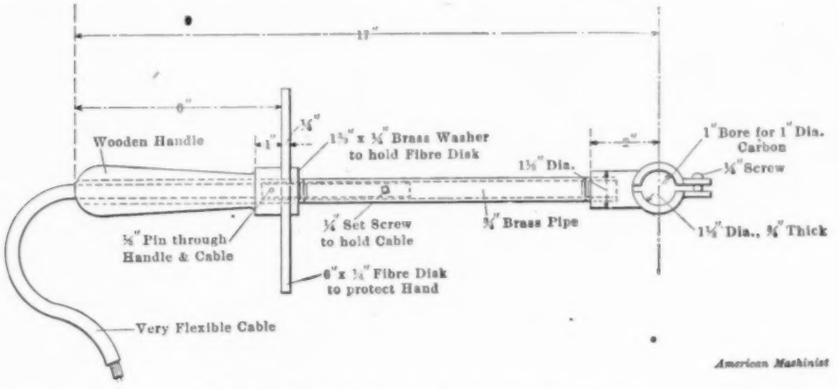


FIG. 2. HANDLE FOR ELECTRIC WELDER CARBONS

From the foregoing description it is not to be inferred that cast iron can be welded by this process, for it has been tried without success. Only steel castings, or machinery steel and wrought-iron forgings can be successfully welded. In welding forgings, a pure grade of iron should be used, such as staybolt iron, as this will give a much more satisfactory job. If this apparatus is installed where other men are working, it will be better to inclose it as the light attracts attention and sometimes causes the men in the vicinity an excuse for loafing around examining the operation. Furthermore, it will be found convenient for the operator to leave all the tools connected with the welder under lock and key.

It is remarkable how many jobs can be found for it after it is once in operation. Copper trolley wires can be welded together so that it is impossible to find the weld. This is a big improvement over the usual way of brazing or soldering, with the continual breaking. A striking illustration showing the extent to which such a device can be used is the following: A new locomotive boiler had been condemned by a railroad inspector in one of the large locomotive shops, due to a small leak in the mud ring, which showed up in testing. Ordinarily the whole boiler would have to be taken apart to get this mud ring out and put it under the hammer again. The material was simply chipped out around the leak and the electric welder made a tight job of it.

The accompanying illustrations show clearly the construction and operation of this welder, which any electrician with any ingenuity can duplicate. This apparatus is now being used in the various plants of one of the largest industrial corporations in the United States.

An Unusual Way to Keyseat a Pulley

By D. O. Barrett

Recently a large dynamo pulley came into our shop to be bored and re-keyseated. The pulley was a paper one, 24 inches in diameter with 25-inch face. The hub of the pulley was 12 inches long and was to be rebored from 3⅞ to 4⅝ inches.

As our shop is equipped for manufacturing gasolene engines no ready facilities were at hand for doing the keyseating. Our machine-shop foreman, however, solved the problem. The pulley was set up on a Niles 54-inch boring mill and the hub rebored. A cutter 5/16 inch wide was fastened at the end of the square steel bar 16 inches long; by means of a screw the cutter was arranged to swivel something over 1 inch at the end of the bar; the bar was then fastened in one of the rams of the boring mill and the job was ready.

The keyway was laid out on the hub of the pulley 1 inch wide and ⅜ inch deep parallel with the cross rail. Two men operated the ram by means of the hand-wheel, while the third man operated the cross-feed and relieved the cutter on the up stroke. The operation of working the ram up and down was somewhat arduous, but the operation was finished in about 1¼ hours, four cuts being taken across the keyway, the depth of the cut being about 1/64 inch. Only one setting of the pulley was required so that the keyway came in perfect alinement with the boring of the pulley.

For many purposes wrought iron is superior to steel, although large quantities of soft steel are now used where wrought iron was previously employed. Wrought iron resists corrosion better than steel, as the slag in the fibers acts as a protective coating when corrosion sets in and thus makes for longer life.

Modern Automatic Type Making Methods

Refinement of Machine Design, Unique Methods for Determination of Accuracy of Matrix. The Microscope a Factor of Machine Installation

BY W. J. KAUP

The accuracy of any result, either mathematical or concrete machine construction, is only determined by the accuracy of the means by which the results have been reached, and the art of type making, in which the greatest accuracy is conceded by those who know, would perhaps be better appreciated were we to stop and consider the foundation upon which this concession is based, the building up step by step through the intricacies involved in the various processes that go toward making the master tools or matrices.

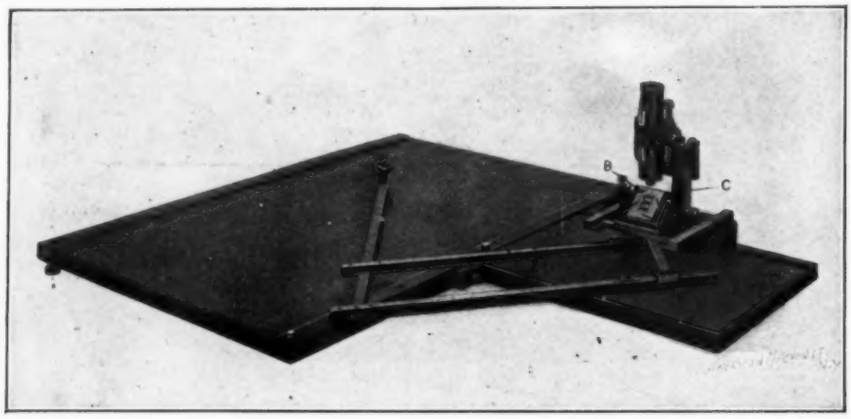


FIG. 1. DELINEATING THE CHARACTERS
A, tracing point; *B*, fingers for clamping character; *C*, bed plate showing angle possibilities.

It is an art where the little things, measured in fractions of a thousandth of an inch are the big things as exemplified by the American Type Founders Company, of Jersey City, N. J., whose system makes each small step a refinement link in the whole chain of microscopic accuracy.

Preliminary

The preliminary work is that of the artist who designs the various characters of type, but this same mind must also be capable of carrying into the machine design, the kind of art that will reproduce itself, because machines have superseded the old-fashioned method of cutting originals by hand, and have enormously increased the production of new type faces. Whereas, in the old days, it took about 18 months to bring out a new Roman face or style of letter, in seven different sizes, at present it can be done in about five weeks, the result being superior to handwork, in both accuracy and uniformity, and having a wider range, and by range I mean size.

When the old-time artist made an unusually small size of type, say, for Bible use, he did it under a microscope, and with great strain on his eyes and nerves; at any moment the tool might slip and spoil the work. With the machine, however, and with no strain whatever, experimental punches have been cut so small as to be legible only with the aid of the microscope, too small, in fact, to print. It is not, however, for the purpose of perfection that the machine is desirable, for perfection in anything is tiresome, but it is essential that the letters be proportioned and shaped in such a manner as to cause the least strain upon the eye in reading, and at the same time produce a pleasing effect. When the printed page is viewed as a whole, and conveys information to the reader without attracting attention to itself, it is ideal, and the purpose and function of the machine is to give us that result.

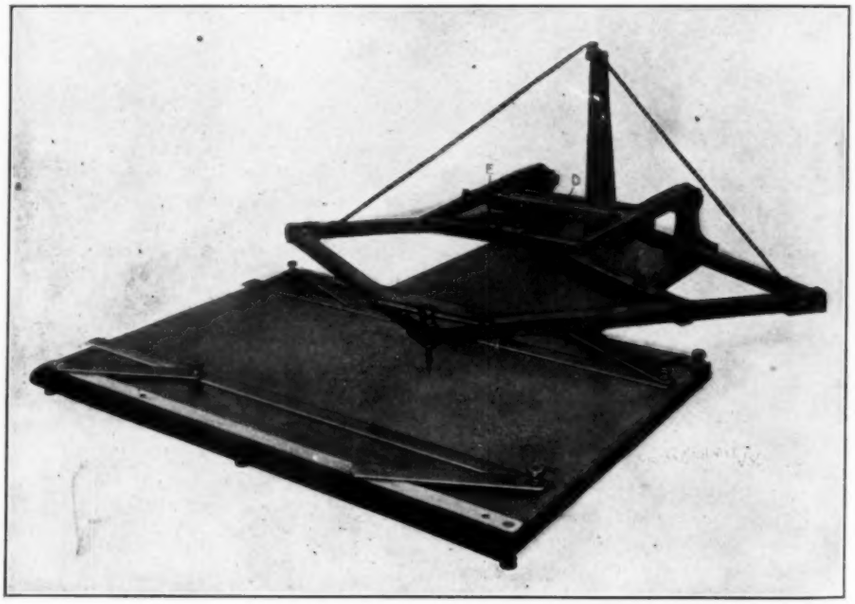


FIG. 2. DELINEATING ON WAX PLATE
D, tracing point inverted; *E*, frame for holding plate.

Development of Pattern

When the design of the character or letter has been satisfactorily determined upon, being either submitted to the firm or originally designed by them, it is placed upon the delineating machine, as shown in Fig. 1, being drawn so large that all errors are easily seen and corrected and begins the first step in its round of reproduction.

This machine is a refined pantograph with microscope attachment. Directly beneath the focal point of the microscope is a small bed plate or holder upon which is placed the model character or letter clamped in place by means of spring fingers. The intersection point of the crosshairs of the magnifying instrument is focused on the outline of the character and the construction of the machine allows for constant change of position of the drawing, and consequently this intersection point which is made to follow the outline of the complete character and the pencil point of the extension arm of the machine reproduces the character enlarged.

The bed of the holder upon which the

original character is laid, can be swiveled to any angle, thereby changing the style of the letter to wide, narrow, back slope or italic, both the italic and back slope being produced through the combination of angles. This machine has a range of production from 0 to 96 point.

A Reversal of Form

When the original design submitted is large, the machine reproduction is backward, and reproduces it in small form by removing the microscope attachment and in its place attaching a small pencil arm which traces the outline of the letter by moving the long arm pencil over the large outline. This small letter is then filled in solid, that is, leaded, and carefully inspected. This solid letter lends itself more readily to criticism. The focal length of the delineator can be changed to meet the requirements of changes in size of letter, the smaller the letter the higher the magnifying power required to produce the same error.

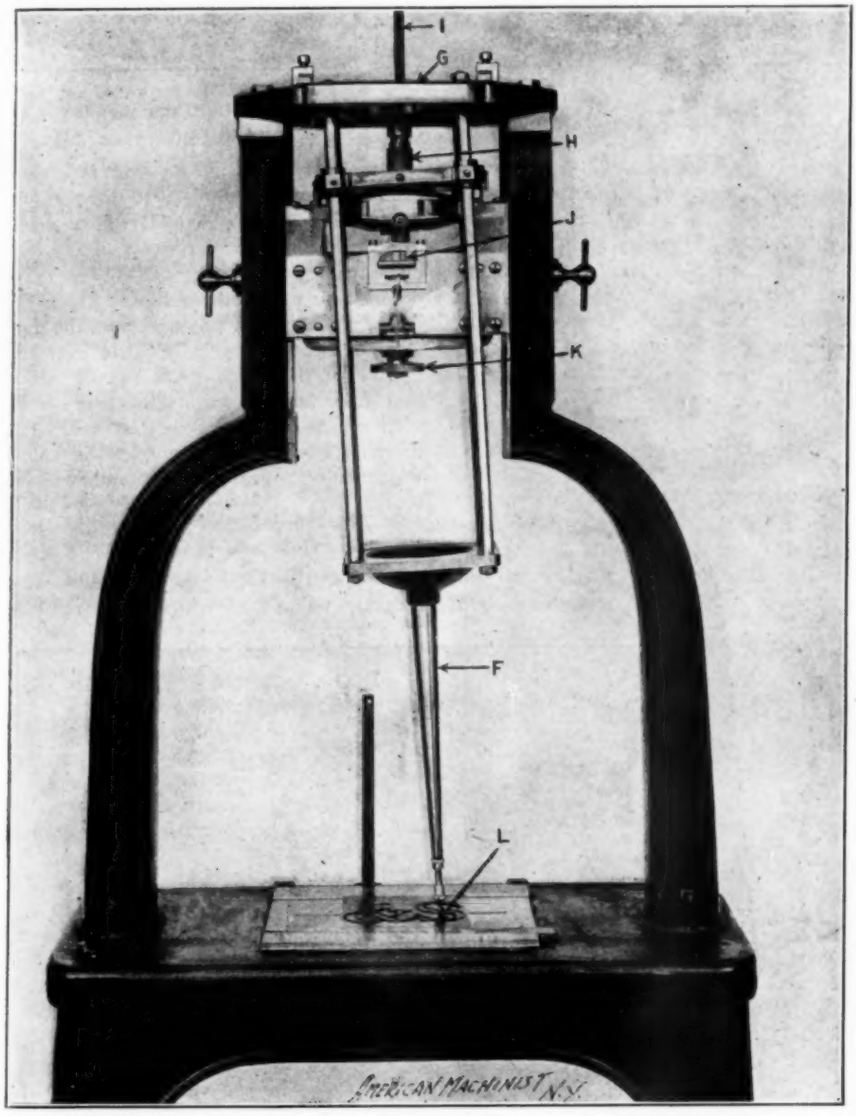


FIG. 3. MATRIX ENGRAVING MACHINE
F, pendulum; G, yoke; *H*, quill; *I*, flexible shaft drive; *J*, matrix; *K*, micrometer adjustment; *L*, follower.

The Wax Impression

The next step in the development of the letter toward the pattern stage is the outline in wax, which is made on a pantograph machine specially designed to hold a plate that has been coated with wax. This plate is held in a horizontal position at the top of the machine, as shown in Fig. 2.

Immediately under the tracing needle, which works on the face of the wax plate in an inverted position, is a mirror to enable the operator to follow the movements of the needle through the varying outlines. This enlarged drawing is larger than the pattern size, so it is not only reproduced, but also reduced in this second step.

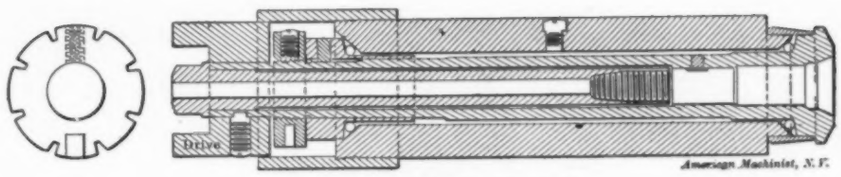


FIG. 4. CONSTRUCTION OF QUILL

The Pattern

From this machine, after the ragged edges of the wax have been removed, it is electrotyped, a process which deposits in the outline sufficient metal to leave a raised character when the wax has been removed. This is "backed up" with metal, trimmed and finished similar to an ordinary electrotype plate of a page of type. This pattern is now ready for use as a model in the engraving machine.

The Engraving Machine—Its Construction and Principle

In Fig. 3 is shown the next step in the evolution of the type, the matrix-engraving machine, which consists of two housings between which swings a long pendulum or arm, which is delicately suspended in a compound yoke by means of gimbal screws which gives it a toggle-joint effect. The whole accuracy of the matrix lies in the accuracy of this machine. The quill holder, or the head which holds the tool in the matrix machine, and the work in the punch-making machine, which is built on the same principle, is fitted between hardened, ground and lapped guides or ways, and is perhaps the most highly developed of the many parts that go to make up the machine design. The steel is specially selected and machined and then laid away for three or four months for seasoning or adjustment of the various strains inherent in all steels. It is then carefully fitted in its guides. The central hole in which the quill or tool holder is

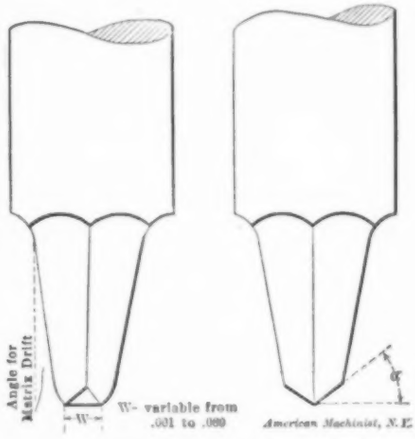


FIG. 5. ENGRAVING TOOL SHOWING FACETS

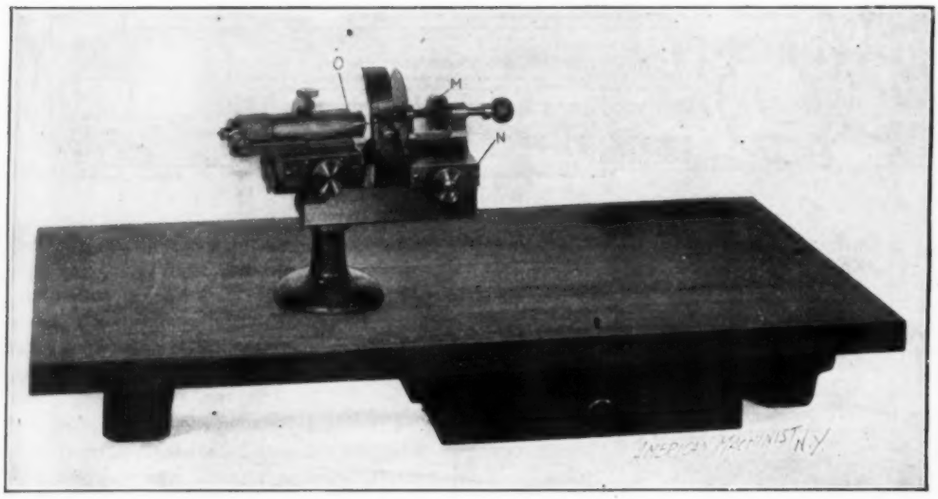


FIG. 6. GRINDER
M, diamond: *N*, micrometer for wheel adjustment: *O*, stop collar.

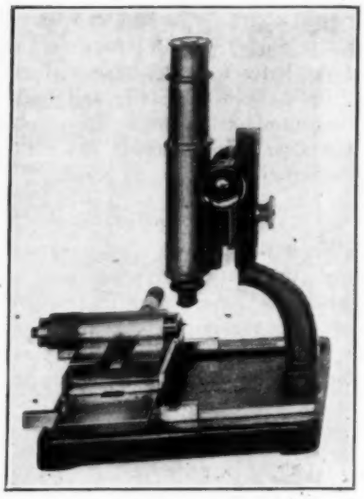


FIG. 7. INSPECTION APPARATUS

held is arranged with positive stop upon which the holder rests, insuring replacement at accurate depths.

The limits of accuracy in the whole construction of this head is within 0.0002 inch. The head which holds the work has a vertical adjustment for the purposes of increasing or decreasing size of matrix character by changing the ratio of tool movement to follower movement.

This head has a central recess at right angles to the plane of the supporting points, in which is held the matrix holder, which accurately fits the sides of head sliding in over beveled ways against another positive stop, which in turn allows for replacement of holders, a T-headed bolt which is actuated by cam screw, drawing the holder solidly in place. The bed plate upon which the holder rests is in turn adjustable and is controlled by the index wheel, as shown at the bottom of the head in Fig. 4, and is actuated by the nurled screw below it. Each notch regulates the movement up or down 0.0001 inch for varying depths of cut, and is held in place by a spring latch. The pattern is held flat on the bed plate of the machine by means of a thin brass wedge.

The Quill

In Fig. 4 is shown the details of the tool holder which is self-explanatory. The central spindle holding the draw-in chuck, which is hollow, and through which the tool is inserted, runs on ball races to eliminate friction. On the end of the central or revolving sleeve are seen eight slots accurately spaced at 45 degrees, which are used in reproducing the correct outline of tool edge. The two extension lugs on the same end are used for driving the whole tool mechanism. The ring edge on the front end of the sleeve serves as a stop, so that when the tool breaks or becomes dulled the quill can be taken out, the tool reground and the whole reset to the same positive depth of cut.

The Tool

The tool has the outline shown in Fig. 5, which shows the faces of chisel cutting edge, which vary in size from 0.001 to 0.080 inch in width, the heavier faces being used for the removal of stock and the finer ones for outlining of the characters. The tool is driven by means of a flexible shaft at a speed of 8000 to 10,000 revolutions per minute.

The Follower

This rests on the pattern and is guided by the swinging pendulum or arm, in the end of which is inserted a pin with a ball end which rests in the socket of the follower, and a light spring in tension against the end of the pin holds the follower always in position. The size of the follower is in direct ratio with the size of the tool, as for example, the pendulum arm with a ratio of 10 to 1, using a tool with 0.008 inch face, would require a follower 10 times as large, or 0.080 inch diameter.

The arm moves the follower along the raised edges of the pattern and the tool which is controlled by it also, cuts the outline of the work. A roughing cut is first made and the surplus stock removed, after which a finishing tool is used. The material used for the matrices is called watchmakers' nickel and resembles hard brass.

Grinding Machines

In case the tool edge should become broken or dulled, necessitating its removal

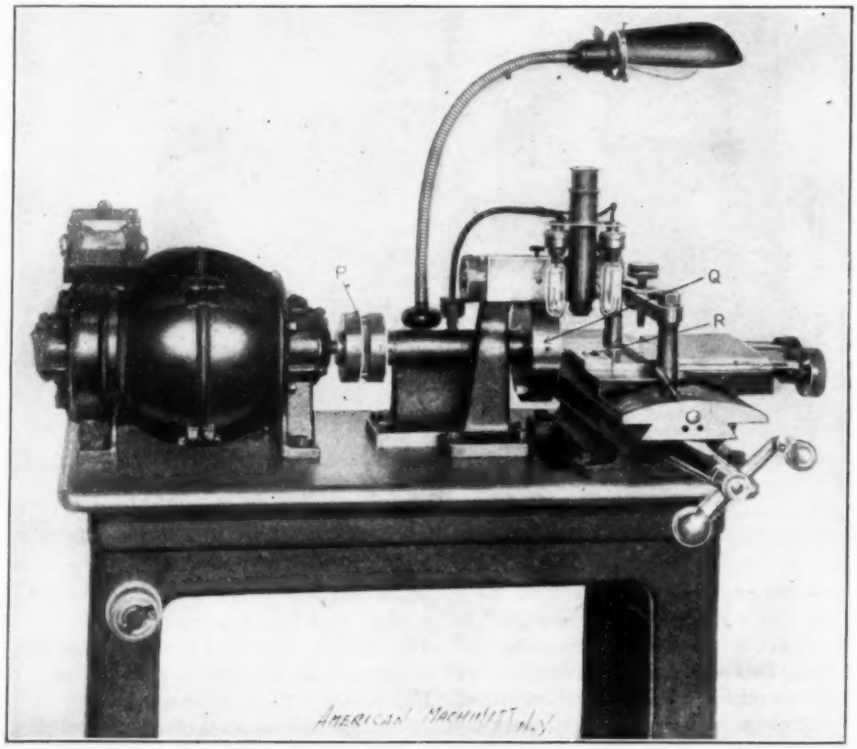


FIG. 8. MATRIX-FIXING MACHINE
P, clutch drive: *Q*, cutter holder: *R*, fixed face of matrix.

in the midst of the operation, it is essential that some means of grinding or renewing the edge be employed that will at the same time insure the same accurate outline of the tool, but more important than all else, the same size and length, and in Fig. 6 is shown a specially designed grinder with small slide rest upon which the quill is held during the grinding operation. The machine consists of a light steel spindle having longitudinal motion by means of which the feed is obtained. On the end of this spindle is mounted a small emery or abrasive wheel. The slide rest is constructed with single trunnion bed which enables it to rotate at the will of the operator, through an arc of 90 degrees, with stops, one of which controls the angle of the tool for matrix draft, and the other the curvature on the end. On the top of the slide rest are two beveled ways with a fixed stop on one end, the quill being held in position on these ways with the ring end against the stop. This ring end is the determining point in this machine for the length of tool and in the engraving machine for the depth of cut.

During the grinding operation, the abrasive wheel naturally wears away and if this were not taken into consideration the size of the tool would be changed. To obviate this, a fixed diamond point, which is also capable of micrometer adjustment in case of wear, is so arranged that the wheel is brought to touch it in passing, thereby insuring the same relative position of the side of the wheel with the tool and grinding the tool always to the same size and contour.

Any desired width of tool face is obtained by means of hardened steel measuring blocks and when a tool of any desired face is ground, the block for that particular face is placed between the end of the ways and the traveling rest brought against it by means of a screw feed, thus changing the position of the tool center relative to the center of rotation.

Inspection

To further insure that the grinder has done its work accurately, it is taken to the machine as shown in Fig. 7 and a microscopic inspection takes place. Across the center of the face or lens of the microscope, is arranged a fine scale reading in 0.0005 of an inch and the edge of the tool is brought in alinement with the scale and an accurate reading is readily obtainable.

Alinement of Matrix

After the letter or character has been machined it is necessary that a fixed relation exist between it and the sides and top of the bar in which it has been cut, on account of the proper spacing of the type when set. Certain type, on account of their shape and general proportion, such as capital H, O, and lower case o and m are used to set the machine, practically for the whole alphabet. In Fig. 8 is shown the matrix-fixing machine, a specially designed facing machine with inserted-tooth face cutters, which is driven by a clutch rather than a belt on account of the belt tendency to pull sidewise, causing undue wear on the spindle and destroying the accuracy of the alinement. The work is clamped on the machine by means of a frog clamp directly under a microscope that has 2 cross hairs at right angles to each other and one hair adjustable to any angle and by means of which the parallelism and position of the letter is fixed with relation to the cutter.

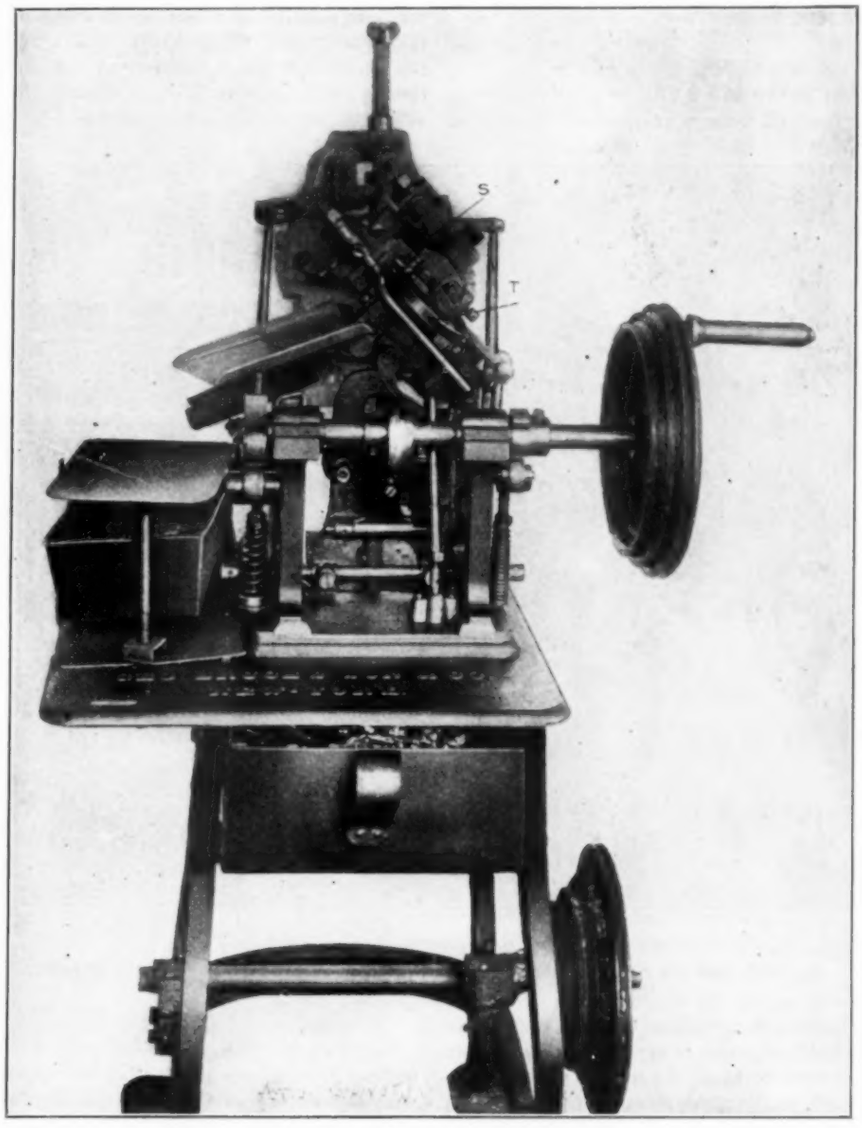


FIG. 9. OLD TYPE HAND MACHINE
S, mold with spring control; *T*, spring.

The Mold

The mold to receive the matrix is made of hardened steel, and in it is formed the body of the type. The printing end is formed in the matrix, the mold is provided at one end with a guide for holding the matrix snugly against it while the type is being cast, and for withdrawing the matrix and opening the mold when the type is discharged. At the opposite end from the matrix is an opening through which the melted metal enters. The molds are made adjustable so that each character is cast the proper width. Only one mold is necessary for one size of type, and with it all the matrices for that size may be used.

The matrix or master tool which is now ready for the type-founding machine is ready for a conclusion, the type itself is accepted as a conclusion and like all conclusions has been arrived at through a chain of reasoning, and the set of machines that form this particular chain of accurate reasoning is the result of a mind grown ripe in the development of type founding—L. B. Benton, who is still at work refining these already refined machines.

Old Style Hand Machines

For purposes of comparison, between the old and the new, and what the change

really means from an economic standpoint, we must consider the saving in the number of handlings the type received, and Fig. 9 is intended to show the earlier methods, in which were involved repeated handling of the product, which is not only expensive but changes the work from an interchangeable to a hand product with no two lots exactly alike. The product from this machine or type of machine has to pass through such operations as taling, burring by means of wiping across the face of a polishing wheel, grooving, sizing, etc.

Automatic Machine

As shown in Fig. 10, the product passes through all these operations automatically.

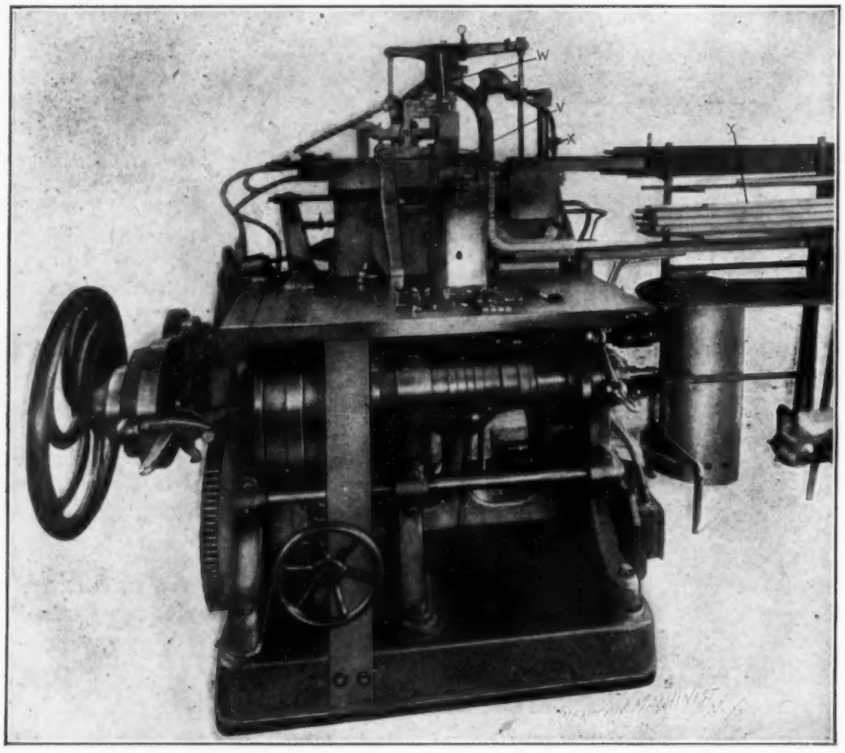


FIG. 10. AUTOMATIC MOLDING MACHINE

V, mold and matrix; *W*, plunger controlling flow of metal; *X*, knives for trimming type; *Y*, showing "sticks" as they are removed.

Through the medium of cams the matrix holder or mold is carried backward and forward, bringing the mold immediately in front of the feed point of the metal. A pump is used to operate in the molten metal to force the metal into the mold and matrix at every operating revolution of the machine. These machines run at different speeds according to the size of the type; the smaller the type the faster the speed, owing to the chill necessary for set. At each revolution a charge is forced into the mold, the time of revolution calculated to chill the type to the proper hardness, the arm controlling the holder is pulled back and the type ejected into a trough and automatically carried along a broaching channel which trims all burs, tales it, grooves it and finishes it complete, ready for use. The type are delivered side by side on a specially grooved piece of wood, 3 feet long, called a "stick," on which they are removed from the machine for inspection. Type are cast at the rate of from 10 to 200 per minute, according to size, the speed being limited only by the time it takes the metal to solidify. To accelerate this a stream of cold water is forced through passages surrounding the mold, and a jet of cold air is blown against the outside. The type are made from type metal, a mixture of lead, tin, antimony and copper. As antimony expands in solidifying, advantage is taken of this quality and the mixture is so proportioned that the expansion of the antimony will practically counteract the shrinkage of the other constituents.

Type Standards

Formerly the various sizes of types were indicated by names which had developed with the history of type making. It was a source of considerable annoyance to printers that these old standards were not accurate, and that two types of supposedly the same size and sold under the same name by different makers, varied so much that they could not be used side by side. At present the "point" system, by which each size bears a proportionate relation to every other size, is the basis of standardizing, an American point being practically one seventy-second of an inch. Actually it is 0.013837 inch. It is based on the pica size, most extensively used in this country. This size was divided into twelve equal parts and each part called a point; and all other sizes were made to conform to multiples of this point. The point is so nearly a seventy-second of an inch that printers frequently calculate the length of the pages by counting the lines, the basis being 12 lines of 6-point, nine lines of 8-point, 6 lines of 12-point, etc. This calculation is quite accurate.

German Lifting Magnets

By Frank C. Perkins

Many unique forms of lifting magnets have been designed in Germany as well as in America, and their application in connection with the use of electrically operated cranes is of special interest. A special electric crane was designed and built by Ludwig Stockenholz, A.-G., of Wetter o-Ruhr, in Westphalia, for the Georgs-Marienhütte in Osnabrück. This was equipped with lifting magnets that operated successfully with the crane working at its utmost capacity.

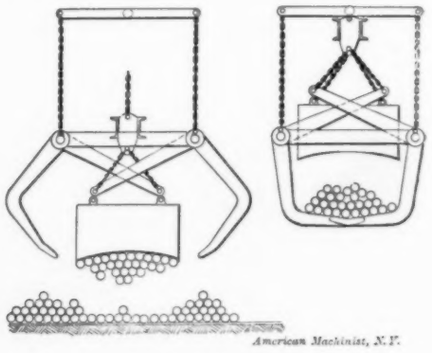


FIG. 1. COMBINED MAGNET AND TONGS

In connection with this crane there was a question of transporting hot as well as cold ingots, and as it is impossible to raise ingots of over 750 degrees temperature by the aid of a magnet, a second lifting appliance had to be provided for the hot ingots. A pair of tongs capable of being controlled from the operator's cab in the electric crane was designed in addition to the magnet of two tons' lifting power. These grippers also act as a protection in case the current is shut off, and Fig. 1 shows the magnet and tongs as it is handling tubes.

By Figs. 2 and 3 are shown two German lifting magnets. The latter is raising a bundle of metal scrap, while the former is holding a number of steel channels, and this is equipped with an electric motor that operates movable arms which revolve to a position under the channels, as shown, to protect them from falling should anything go wrong. These take the place of the tongues shown in Fig. 1.

These German lifting magnets, as well as that shown in Fig. 4, as it is raising a number of cast-iron pigs, were designed and constructed at Berlin, by the Siemens Schuckertwerke. These forms of lifting magnets have been constructed of from 3 to 15 tons' capacity.

In some magnets the magnetic attraction of the inner pole has been purposely made stronger than that of the outer pole. The practical effect of this is that in handling pig iron or similar material the bulk of the pieces, constituting the lift, are drawn toward the center of the magnet, thus enabling the crane operator to drop the load within a much smaller area than is possible with magnets in which the flux is so distributed that the pieces of metal, lifted, tend to cling to the outer edge of the magnet frame.

It may be stated that it is an electrical axiom that the torque exerted by a motor of constant field strength, will vary with the strength of the current admitted to the armature winding. This principle is utilized in the case of the cable take-up by inserting in the armature circuit of the motor a fixed resistance which limits the amount of current passing through the armature, and consequently limits the pull which the motor can exert on the cable to a predetermined maximum, that is just sufficient to keep the cable taut at all times.

Now the current for energizing the magnet is transmitted to the cable by collector rings. One of the wooden strips forming the drum is pierced with a small hole through which the end of the cable that is connected to the collector rings is passed. The cable is then wound up on the drum and the other end connected to the cables issuing from the terminal box of the magnet.

With every magnet of this type of large size, say 35 inches and upward, a drum-type master controller and discharge resistance are used and the control switch consists of two parts—the master controller and a solenoid-operated contactor. The master controller should be installed in the crane cab within convenient reach of the operator, while the contactor and resistance may be secured to any portion of the cab, either inside or out.

It is well known that when the circuit is suddenly opened on a magnet coil there is a strong inductive reaction, or "kick," the effect of which is to reduce a high voltage at the terminals of the coil. Constant repetitions of this "kick" will sooner or later break down the strongest insulation unless provision is made for guarding against this inducted voltage and dissipating the energy outside of the coil itself.

In this system of control the force of the inductive reaction incident to the opening of the circuit is minimized by having a discharge resistance automatically shunted across the magnet terminals just prior to the opening of the magnet circuit, this resistance being disconnected automatically prior to the reëstablishment of the magnet.

FIG. 3. MAGNET LIFTING BUNDLES OF SCRAP

FIG. 4. LIFTING PIGS WITH GERMAN MAGNET

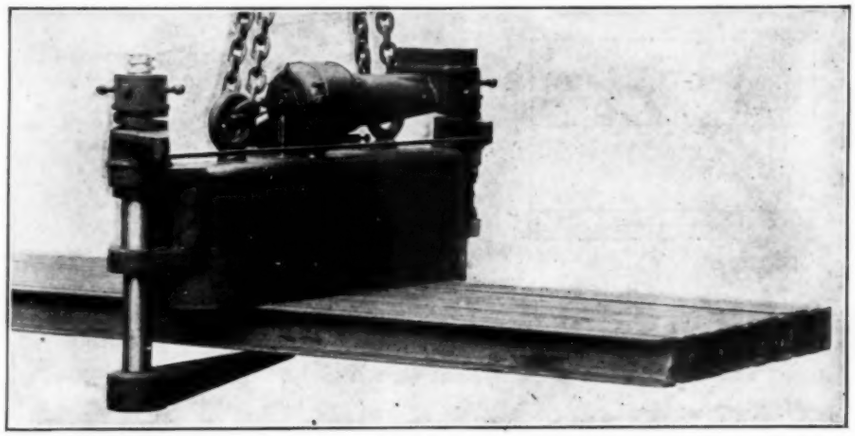


FIG. 2. GERMAN MAGNET WITH REVOLVING ARMS TO PROTECT WORK FROM FALLING

The facts and figures contained in the forthcoming U. S. Census Bureau bulletin on lumber, lath and shingles in 1908 disclose the adverse conditions obtaining in the lumber industry during that year. A summary of the total values for the several groups of forest products investigated shows $698,262,175 for 1908 as against $897,941,736 for the previous year.

A New Stunt in Annealing Air Hardening Steel

By R. D. Bromley

We see occasionally in your columns, something pertaining to air-hardening steel, which is always an interesting subject. I have had occasion to handle nearly all brands of this kind of steel, for some years past, and quite recently stumbled onto something new to me in regard to it.

All workers and users of this steel know that without annealing, no tool will cut it. And this requires some 30 hours or more; often a serious loss of time.

Where I am employed, we use this kind of steel for dies and punches, in stamping out certain parts from heated bars of steel. These tools require to be dressed quite often, which is done by hammering on the face side when at a cherry-red heat, and crowding the edges over enough, so a sharp edge and a perfect fit can be obtained by filing the cutting edge. This could not be done by grinding and hence time is lost in annealing them.

Not long since, I took the two halves of a die, weighing perhaps 10 pounds, and worked the edges as usual; laying the first piece upon the forge, face side up, and placing the second piece directly on top of the first when both were hot. When cool the under piece we found by chance, could be filed easily, but the top one was as hard as ever. I heated this one on the face side, and placed another hot piece upon it, getting the same result, and in less than three hours these tools were in their press and in use. I have since treated other pieces the same way with the same result. This was a new one to me and it may be to other steel workers.

Practical Letters from Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

Two Attachments to Standard Steel Scales and a Small Bevel Square

The tools described were made to facilitate die repairs, especially square and rectangular dies, such as dies for roasters, bread pans, etc., of which we use a great many. These dies are in a great variety of sizes, and the angles between the sides and bottom vary for nearly every size, so the making of templets for repairs and renewals is quite an item.

Fig. 1 shows a caliper square head with screw adjustment, made to fit a 24-inch Starrett steel scale, No. 7 graduation. Another head was made the same, but without the screw adjustment.

The feature of this attachment is that either outside or inside measurements may be taken with it and read direct from the scale. The drawing shows clearly the construction. The measuring leg is made of tool steel, and is fastened to the side pieces by three screws and two taper dowel pins. It is hardened on the measuring edge and on the edge in contact with the scale. The two sides are riveted together at the top, the inserted piece being the same thickness as the measuring leg and being cut out for a small curved spring which rests on the gib piece. This spring gives an easy sliding fit without shake.

As will be noticed, the measuring line is in line with the face of the measuring leg, thus reading direct from the scale, and by reversing the scale in the heads readings can be taken from any edge of the scale.

In use, the head, without the screw adjustment, is put on the scale and clamped at any convenient inch graduation, the head with the screw adjustment is then slipped on the other end of the scale and adjusted to the size of the piece being measured. The reading of the measurement is then got by subtracting the number on the scale at which the first head is set from the reading of the adjustable head. For inside measurements on parallel surfaces the heads are reversed on the scale, the readings being taken in the same way. For inside measurement of other than parallel surfaces, the attachments *A* were made, one of which is slipped on each leg and tightened by the eccentric pins *B*. These attachments are ground parallel and to a smaller circle than the tool will measure, thus insuring correct measurement. The width of these attachments being each ½ inch, the addition of 1 inch to the readings found in the way explained gives the correct reading while using them.

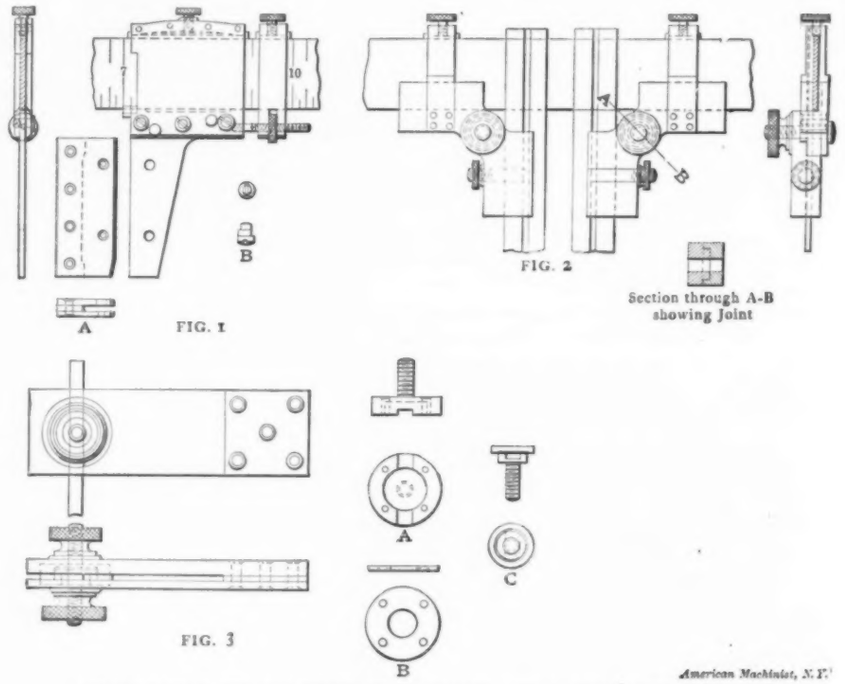
Fig. 2 shows a bevel- and taper-gage attachment which was made to fit the same scale, but can be made to suit any size of scale. As can be seen by the drawing, the attachments are made one opposite from the other, the reason for this being to bring the two small scales both to the same side of the large scale. It will also be seen from the construction that the scales lie close back to back when clamped, this bringing the two small scales in line with each other. By loosening the large thumbscrew any angle can be got within the capacity of the tool, which capacity will be seen to be quite large enough for the ordinary run of work, as the attachments can be reversed on the scale. The construction needs no explanation, the drawing being clear enough. The ordinary clamps as used in combination squares are used for the small scales, as shown.

For making the dies referred to, especially when making duplicates, this tool shows its worth, as it can be quickly set to both the angle of the sides, the depth and the size inside of the die, thus doing away with the necessity of making a templet on a rush job. It can also be used as a bevel square using one head, or as a taper gage for long tapers using both heads. For smaller work I use them on a 12-inch scale in place of the 24-inch scale, using a parallel packing piece between the gib piece and the scale.

While these two attachments to the standard steel scale are not, perhaps, for precision work, still they are accurate enough for ordinary work, are comparatively inexpensive, take up little room in the tool box and weigh little.

Fig. 3 shows a small bevel square which I have found useful in small die work. The narrow blade permits its use in places where the usual bevel square is impracticable.

The feature of the tool is that the blade can be pushed through far enough to permit setting the bevel by a Starrett or other protractor with revolving button center. When the required bevel is obtained the smaller thumb screw is tightened, thereby clamping the slotted disk. The blade can then be pushed back to any desired length and the larger thumb screw tightened with the assurance that the bevel is correct. With the usual bevel square, when a short blade is required one cannot set it by the protractor without the use of a scale as well, which makes it rather awkward. The details *A*, *B* and *C* show the two clamping bolts. The disk *B* is riveted to the face of *A*, after the head of the bolt *C* is inserted in *A*. These bolts must be put in place before the two sides



ATTACHMENTS FOR STANDARD STEEL SCALES AND A SMALL BEVEL SQUARE

of the stock are riveted together. Care must be taken in fitting the slot in the bolt *A* so that there is no side play.

Edinburgh, Scotland. T. H. N.

A Table for Calculating Pitch Diameters of Worms

The accompanying table was calculated with a view of enabling one to read off the pitch diameter of a worm of any given outside diameter at a glance.

It has proved a great time saver, and may be found useful by other readers of the journal. The table gives the pitch diameters for worms of all the common pitches for a range of outside diameters from 1 to 1 15/16 inches, varying by 1/16 inch. A few examples of its use will illustrate its wide application.

Given a worm 2 3/16 inches outside diameter, 7/16-inch pitch. The table gives for 1 3/16 inches outside diameter, 7/16-inch pitch, a pitch diameter of 0.909 inch. Therefore, 2 3/16 inches outside diameter, 7/16-inch pitch, must be 1.909 inches pitch diameter. Given a worm 4 13/16 inches outside diameter, 11/16-inch pitch. From table 1 13/16 inches outside diameter, 11/16-pitch = 1.375 inches pitch diameter. Therefore, 4 13/16 inches outside diameter, 11/16-inch pitch = 4.375 inches pitch diameter. Given a worm 7/8 inch outside diameter, 5/16-inch pitch. From table 1 7/8 inches outside diameter, 5/16-inch pitch = 1.676 pitch diameter. Therefore 7/8 inch outside diameter, 5/16-inch pitch must be 0.676 inch pitch diameter.

The practical use of the addition of the whole inches is, of course, done mentally and very easily and quickly. The claim to novelty lies in the limiting of the table to diameters between 1 and 2 inches, thus enabling the increments of 1/16 inch to be given, and still to be used over a large range of sizes.

Bristol, England. J. B.

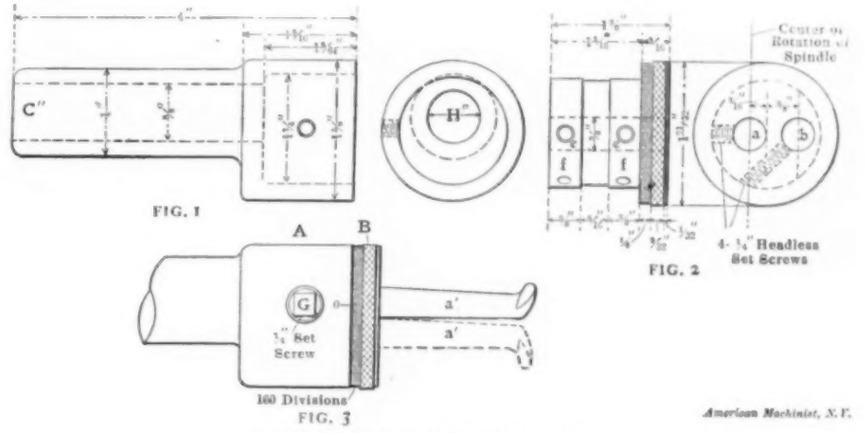
Adjustable Jig Boring Tool Holder

Several recent issues of the AMERICAN MACHINIST have contained descriptions of jig boring-tool holders which lead me to submit the design of one I made some years ago and which, for simplicity of construction and facility of operation, constant use convinces me, "can't be beat." I have never seen this design published and its description and dimensions may be of interest to your readers. It is very easy to make, being nearly all lathe work since the graduations on *B* may be omitted, these being a refinement of the general design not strictly essential. *A* is made of machine steel and can be made complete in the chuck in two settings, using a piece 4½ inches long and cutting off at chuck end *C*.

B is turned to fit the 1¼-inch bore a snug fit without shake; boring-tool holes *a* and *b* are drilled in the drill press, and the tools, made of ⅜-inch round tool steel, are held in position by the headless screws *c c'* or *f f'*. Further adjustment is obtained by releasing set screw *G* and rotating eccentric bushing *B*. At one point hole *a* is concentric with the shank of *A* as shown in Fig. 3. Hole *b* gives a still larger diameter.

I made this holder with a straight shank in order not to confine its use to one machine. For permanent use in one machine it should have a taper shank to fit the spindle. Hole *H* is drilled to lessen the weight, a prime consideration in a tool for one's tool-kit.

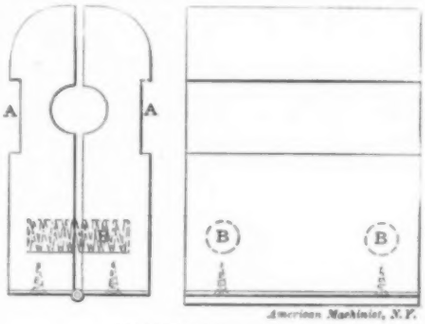
Cleveland, Ohio. PAUL CAMPBELL.



ADJUSTABLE JIG-BORING TOOL HOLDER

Wooden Vise Jaws

The neatest arrangement of wooden jaws I have ever seen is shown in the accompanying line cut. They are held together at the bottom by a common steel hinge.



WOODEN VISE JAWS

Of course, they will not hold all sizes of work, but have a considerable range, spindles, etc., being held in the round hole. They are convenient because they are connected together, making them easy to put in place, and they do not drop out of the vise like most metal jaws at the least

Worm, Outside Diameter	Pitch in Inches															
	¾	$\frac{9}{16}$	⅝	$\frac{7}{16}$	½	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{11}{16}$	¾	$\frac{13}{16}$	⅞	$\frac{15}{16}$	1	1 1/16	1 ⅛	1 3/16
1"	.8408	.8011	.7613	.7215	.6817	.6419	.6021	.5623	.5225	.4827	.4430	.4032	.3634	.2838	.2042	.0451
1 1/16"	.903	.864	.824	.784	.744	.704	.665	.625	.585	.545	.505	.466	.426	.346	.267	.108
1 1/8"	.966	.926	.886	.846	.807	.767	.727	.687	.647	.608	.568	.528	.488	.409	.329	.170
1 3/16"	1.028	.989	.949	.909	.869	.829	.790	.750	.710	.670	.630	.591	.551	.471	.392	.233
1 ¼"	1.091	1.051	1.011	.971	.932	.892	.852	.812	.772	.733	.693	.653	.613	.534	.454	.295
1 5/16"	1.153	1.114	1.074	1.034	.994	.954	.915	.875	.835	.795	.755	.716	.676	.596	.517	.358
1 3/8"	1.216	1.176	1.136	1.096	1.057	1.017	.977	.937	.897	.858	.818	.778	.738	.659	.579	.420
1 7/16"	1.278	1.239	1.199	1.159	1.119	1.079	1.040	1.000	.960	.920	.880	.841	.801	.721	.642	.483
1 ½"	1.341	1.301	1.261	1.221	1.182	1.142	1.102	1.062	1.022	.983	.943	.903	.863	.784	.704	.545
1 9/16"	1.403	1.364	1.324	1.284	1.244	1.204	1.165	1.125	1.085	1.045	1.005	.966	.926	.846	.767	.608
1 5/8"	1.466	1.426	1.386	1.346	1.307	1.267	1.227	1.187	1.147	1.108	1.068	1.028	.988	.909	.829	.670
1 11/16"	1.528	1.489	1.449	1.409	1.369	1.329	1.290	1.250	1.210	1.170	1.130	1.091	1.051	.971	.892	.733
1 ¾"	1.591	1.551	1.511	1.471	1.432	1.392	1.352	1.312	1.272	1.233	1.193	1.153	1.113	1.034	.954	.795
1 13/16"	1.653	1.614	1.574	1.534	1.494	1.454	1.415	1.375	1.335	1.295	1.255	1.216	1.176	1.096	1.017	.858
1 7/8"	1.716	1.676	1.636	1.596	1.557	1.517	1.477	1.437	1.397	1.358	1.318	1.278	1.238	1.159	1.079	.920
1 15/16"	1.778	1.739	1.699	1.659	1.619	1.579	1.540	1.500	1.460	1.420	1.380	1.341	1.301	1.221	1.142	.983

PITCH DIAMETERS FOR CIRCULAR PITCH WORMS, U. S. A. STANDARD

touch, the grooves *A A* keeping them in place. Two stiff helical springs are put in at *B*. Threaded work can be held with perfect safety, it being impossible with wood to injure metal. One of the best woods to use is maple, which is tough and does not split easily.

J. O. SURFACE.

A Self Centering Jig for Holding Work in the Drill Press

The line cuts show a chuck for holding work that is to be machined in a drill press. It is superior in a number of ways to any chuck that I know of for this class of work, has a wide range, and will take in a piece 4 inches diameter, or can be changed to take in 12 inches diameter in a very short time. It can also be set so that it will take in irregular work.

To give a better understanding, I have put down a few dimensions of one that will take in about 12 inches. *A*, the base plate, is ¾ inch thick, planed on the bottom. On the top of *A* are three chucking pads *B B B*, also a hub *D*. The top faces of *B B B* are faced true. The hub *D* is left solid, or is bored to suit the job to be done. *C C* are two lugs which are drilled for ½-inch bolts. *E E* are bosses or long hubs drilled and reamed 1⅛ inches. It is important that these holes be at right angles to the bottom and parallel to each other, so that the guide pins *F F* will work easily up and down, also be a snug fit in the hubs *E E*. *G* is a plate, shaped as shown in Fig. 1; it is ¾ inch thick. In the center is a boss 1¾ inches thick and 6 inches diameter, bored to receive the guide bushing, as shown. In Fig. 2 the guide bushing is shown resting on the pulley hub that is to be drilled. This is incorrect; the bushing should never touch the work that is to be machined; only the centering pins *J* should touch the casting. *H H H* are three arms the same thickness as the hub portion, and set at 120 degrees. In these arms are ¾-inch holes to receive the centering pins *J*. These holes are carefully spaced at equal distance from the center of the guide bushing. At either ends are bosses which have 1-inch holes to receive the guide pins *F*. Extending out from these are trunnions machined 1 inch diameter. *L* is a ¼x1¾-inch flat iron lifting lever shaped as in Fig. 1, and drilled for the fulcrum bolts *M M* and the link pins *O*, Fig. 3. The bushing holder is connected to the lever *L* by the links *N N*. The left-hand side of this lever extends 18 inches out from the link and has a handle shaped on the end, as shown.

To operate the jig simply lift the bar by means of the lever *L*, put the piece in and then drop the bar and now it is ready, which is done in the time it takes to tell it. I have shown only one centering pin *J*, but it will be understood that there are three at *H H H*.

Milwaukee, Wis. M. E. DAWSON.

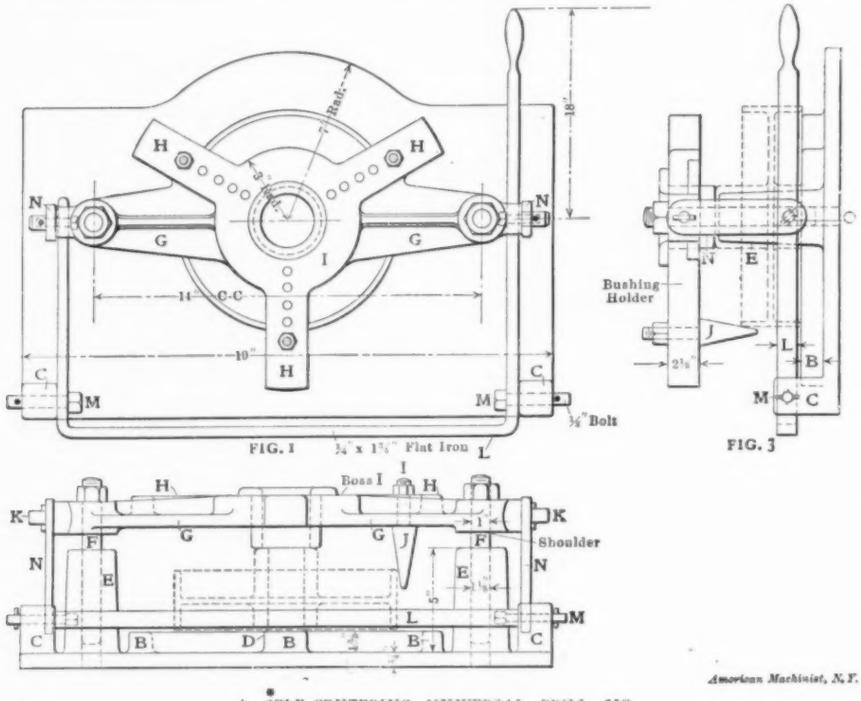


FIG. 1 ¼" x 1¾" Flat Iron FIG. 3

A SELF-CENTERING UNIVERSAL DRILL JIG

Fixture for Machining Two Parallel Eccentric Holes

A large quantity of the brass articles *A* was wanted, the two ⅝-inch holes *X* to be parallel to and in line with each other and equidistant from the center, their centers being exactly ⅞ inch apart. For machining these two holes, this fixture was made and located on the faceplate of a capstan lathe.

The eccentric face plate *B* was machined and the fixture secured to it by the two bolts *F*.

The operations for machining the articles *A* were simple and accurate. They were turned front and back to fit *D*, Fig. 3. Then the four ¼-inch holes were drilled in a jig. They then went to the turret lathe where they were pushed into the hardened and ground bush *D*, and clamped on the locating pin *E*, Fig. 1, as shown in Figs. 1 and 3. The first hole was then drilled with a straight-fluted 19/32-inch drill, a boring tool was put in to correct the hole and was followed by a ⅝-inch spiral fluted reamer. The two nuts *F F* were then slackened, the indexing plug *G* lifted and fixture turned round halfway. The plug *G* then dropped into the other

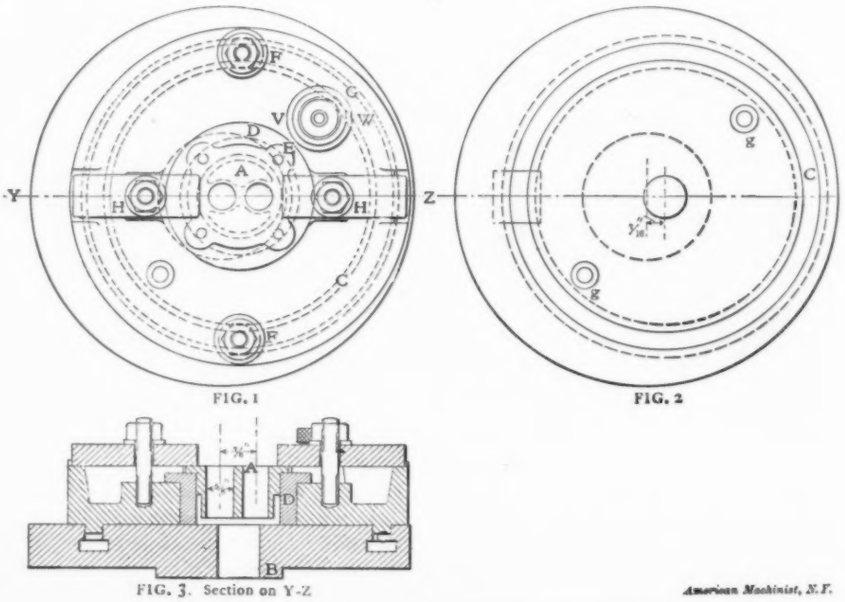


FIG. 1 FIG. 2

FIG. 3. Section on Y-Z

FIXTURE FOR MACHINING TWO PARALLEL ECCENTRIC HOLES

bush. *F F* are then tightened and the first operation repeated.

Birmingham, Eng. E. W.

Cutting a Large Gear on the Boring Mill

The accompanying illustration shows the way in which a large gear was cut on a Gisholt boring mill. The gear was 60⅓ inches in diameter and had 360 teeth. It was found by trial that there was only one speed at which a whole number of turns of the driving pulley made one complete revolution of the table, and on this speed 23 revolutions of the pulley made one of the table.

As there were 360 teeth to be cut the table had to be turned 1/360 for each tooth or 1/360 of 23 = 23/360 of a turn of the pulley.

Accordingly the pulley was spaced off in 360 equal parts and moved through 23 of the spaces for each tooth, a finger having been suitably arranged to gage the movement. A strip of sheet iron was cut just long enough to cover the 23 spaces on the pulley. This was to save counting the spaces each time, as each 23 spaces could not be marked, 360 not being a multiple of 23.

The cutter was mounted on the end of a short shaft to which was keyed a worm wheel which was driven by a worm on another shaft to which was keyed a small pulley, the whole being held in a fixture which was clamped to the head and driven by a motor on the floor.

The cutter having been set central was fed in the required amount by the micrometer on the cross-feed. The head was fed down by hand. The total time for cutting each tooth, including moving the table, was two minutes.

Louisville, Ky. CHARLES E. BARRET.

A Tool for Parting Pieces on the Planer

It is sometimes necessary in machine shops to part large pieces of steel on the planer, and the work, when properly tackled, may be done as quickly and as cheaply in this way as with a circular saw. The difficulty which usually attends such work is that the usual tools are not quite of the most desirable form, even when forged with a good set-back as shown in Fig. 1. They are not sufficiently rigid, they spring under one cut and take double the next stroke, resulting in broken blades; and when a considerable amount of this work is in hand the tool-smith is kept busy repairing tools—a rather expensive item with tools of this class.

By the introduction of a tool and tool holder, such as is shown in Fig. 2, I have considerably decreased the cost of such work; and in an equal degree have I learned the cost of tools and their upkeep.

Several have been made and put into service, and nothing but the holder has been inside the smiths' shop.

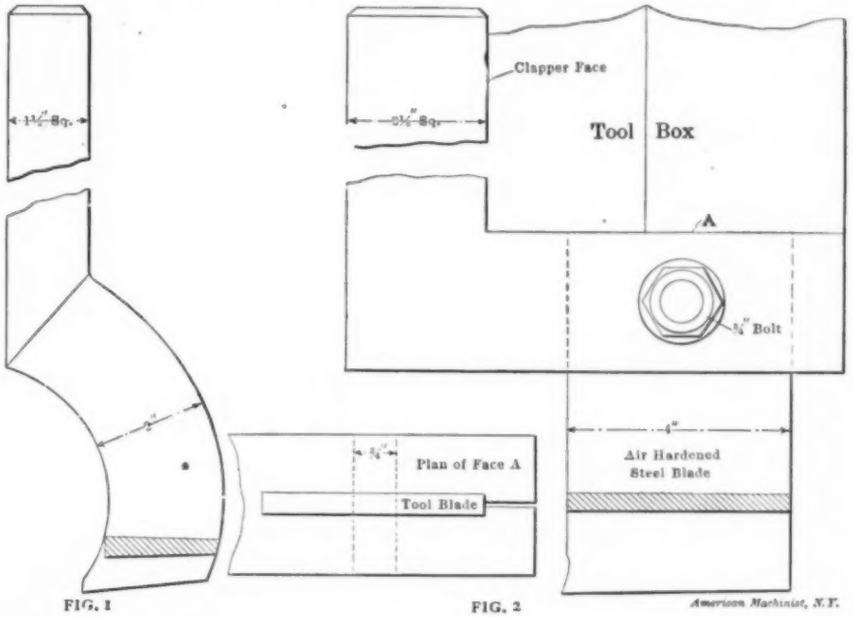
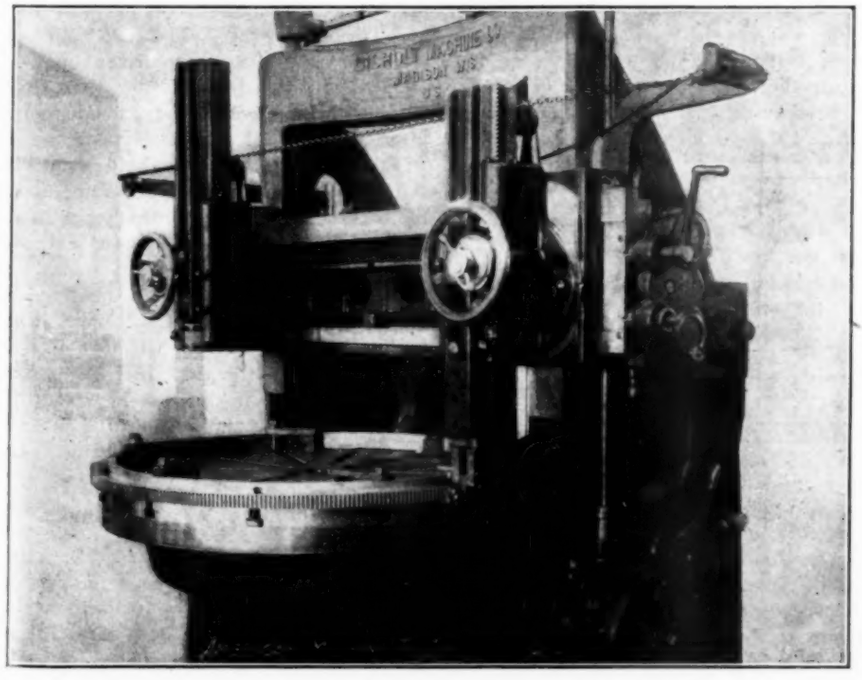


FIG. 1 FIG. 2

PARTING TOOLS



CUTTING A LARGE GEAR ON THE BORING MILL

It will be seen that the holder is made of very substantial form, the part which forms the tool grip being set well back behind the pivot of the tool box of the planer.

The blades are made of ⅜x4-inch air-hardened steel, having a taper section from ⅜ to 5/16 inch. No more is required than to cut the bar into suitable lengths, (for deep or shallow cuts respectively), to grip one in the holder, as shown, and go ahead. No spring takes place, the cutting arrangements are as firm as a rock, and consequently the tool takes its proper amount at each stroke of the planer.

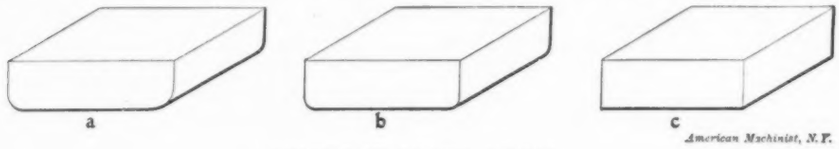
Planer hands will readily recognize the old trouble and will appreciate the new tool. JOSEPH T. TOWLSON.

Silvertown, Eng.

[With the "heel" of the tool set so far behind the pivot of the clapper box, there is considerable danger of breaking the tool on the return stroke, unless some automatic lifter is used. We have used an old easy working strap hinge or a piece of flexible clock spring placed behind the heel of the tool.—ED.]

Shearing Blanks

When a good square-finished edge is required on sheet-metal blanks it is customary to shear or trim them after blanking, the blanking die being large enough to allow trimming according to the thickness of the stock.



SHEARED OR SHAVED BLANKS

Another method that gives better results, sharp, square edges and perfectly flat faces, is to make the blanking die the size of the finished blank, but use thicker stock in the blanking operations than is called for.

The blanks are then flattened or planished to the required thickness in planishing tools in a heavy press which spreads them out sufficiently to allow them to trim up to a good, sharp edge in the shaving tools.

The flattening operation also hardens the blanks, giving them, especially Swedish iron, a better trimmed edge. The cut shows the blanks in three operations: *a* the blank, *b* after flattening, and *c* after shearing. The blanks are put through the reverse way when being trimmed.

London, England. H. HARRIS.

The Position of Manufacturers' Names on Catalogs

From those whose business makes it necessary to handle many catalogs, these few words may bring forth discussion. All the larger concerns print their names on the backs of their catalogs, so that they are recognizable at a glance.

Some of the smaller catalogs are printed in the same way, and these are more often used than those which do not have the firm name on the back. This is especially the case when the user is a busy purchasing agent.

Springfield, Mass. F. L. GAGER.

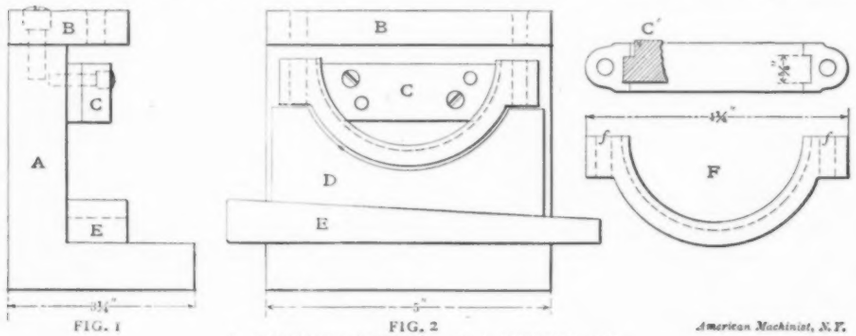
A Combined Drilling and Milling Jig

The inclosed sketch is of a jig used for both drilling and milling the lugs of a small eccentric strap, shown at *F*. *A*, Fig. 1, is gray iron with the plate *B* (the drill guide) screwed and doweled to it. *C* is the locating stop, which is of hardened steel and fits fairly well in the rough ⅝-inch groove in the strap.

The block *D* is of machinery steel about 1¼ inches wide and is forced up by the wedge *E* against the bottom of the lugs of the strap locating the latter with *C* and parallel with the top of the jig.

Fig. 2 shows the work in position ready to be drilled. When used as a milling fixture the plate *B* is first removed. Fig. 1 shows an end view of the jig without the work or block *D* in place. C_1 is a part section of *C*.

This is a cheap, easy jig to make, quick to operate, and about as near foolproof as any tool can be.



A COMBINED DRILLING AND MILLING JIG

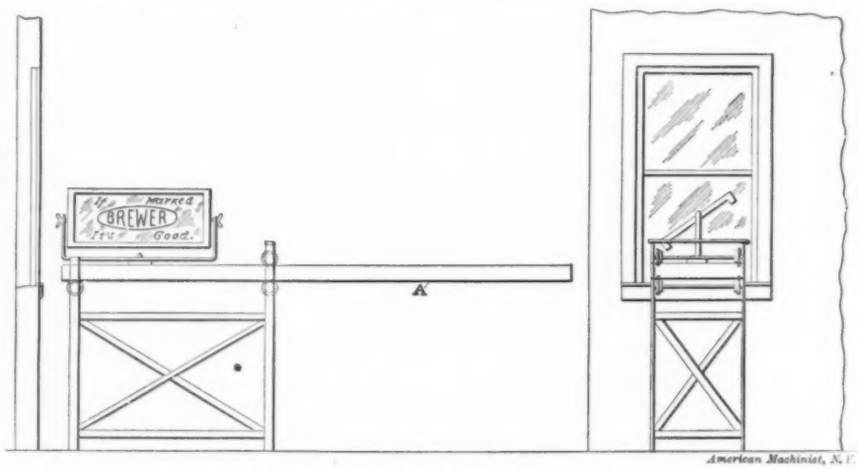
WILFRID J. THOMPSON.

Toronto, Canada.

A Blueprinting Frame and Carrier

Not being equipped with electrical appliances necessary for blueprinting and finding it inconvenient to swing the frame from the window, a scheme was devised to enable the frame to be placed far enough from the building so that the shadows would not interfere.

A stand (occupying a floor space 26 inches wide and 58 inches long) was made with a rolling section *A* placed upon four flanged wheels so that it comes a little above the window sill, as shown, with two wheels above and at the rear end of the stand. These are to prevent the section from over-balancing when the printing frame is shoved out from the window.



A BLUEPRINTING FRAME AND CARRIER

The stand and rolling section are built of Georgia pine. It has to be built in proportion to the hight of the window sill. The wheels are cast iron about 3 inches diameter by 1 inch face, driven upon a ¾-inch cold-rolled shaft, the shaft extending through wheels far enough to be inserted into the legs of the frame.

This stand is made to hold a frame 24x36 inches. In mounting the frame upon the section *A* a wrought-iron bar is used ½x2 inches section and long enough so that ends may be bent at right angles.

The ends form the bearings upon which the axis of the frame turns. They must be high enough so that it will turn freely. Use a ½-inch bolt in the center of the bar for the purpose of shifting the frame in any direction. Make a slot in each end of the bar for the axis of frame. At present we use ⅜-inch wood screws for axis.

Studs ⅜ inch diameter would be preferable so that thumb nuts could be used to hold the frame in any position desired. Fasten the stand to the floor with angle irons. We find this to be a most satisfactory device.

Tecumseh, Mich. L. M. COLLINS.

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

Turning Tapers

The article on "Turning Acute Tapers," by C. R. McGahey, on page 503 of the AMERICAN MACHINIST, interested me, as it is a question that has cropped up on more than one occasion; hence anything new on this subject always arrests my attention.

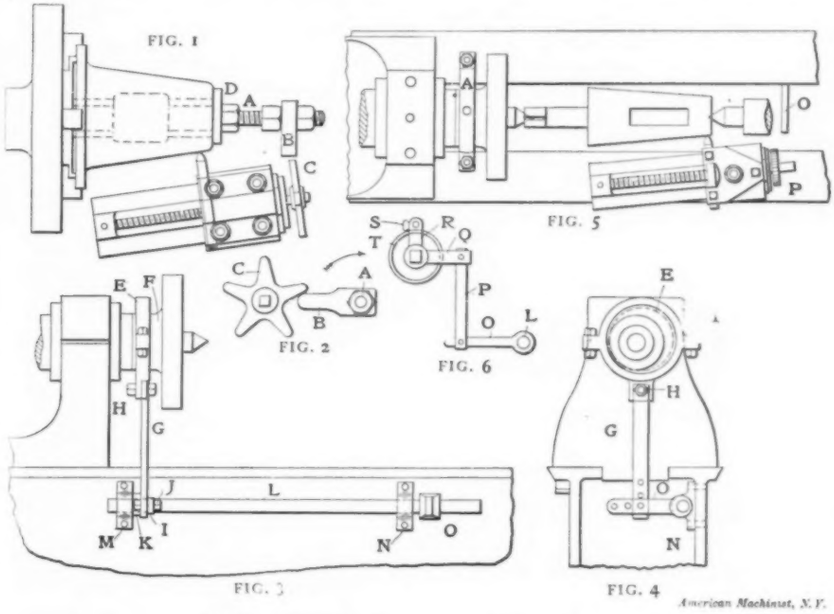
In Fig. 1 is shown a device that was illustrated by a correspondent in the AMERICAN MACHINIST about six years ago. I made one and it has been satisfactory on fairly heavy gray-iron work, such as Corliss engine-valve spindle steadiers, as shown, gripped in a four-jaw independent chuck. A long threaded steel bar *A* is passed through the hollow spindle of the lathe; a clamping plate *D* is then screwed tight up to the face of the casting to give it additional security while being operated upon. A steel finger *B* is gripped by two nuts, as shown, and this comes in contact with the star wheel *C*, on the end of the compound slide-rest feed screw. An end view of these is shown in Fig. 2. Every revolution of the work thus gives an automatic feed to the cutting tool.

Although this rig is cheap to construct, its application is limited, and it cannot be adapted on all kinds of taper work; taper plugs for gland cocks being one kind, and large quantities of these are made in some shops.

I was once employed by a firm who made a quantity of both brass and cast-iron plugs for cocks varying from 1 to 6 inches in diameter, one of which is shown in the lathe in Fig. 5. The method of obtaining an automatic feed to the compound rest was eventually solved, as shown in Figs. 3 to 6.

Referring to Fig. 3, which is a side elevation, with the front of the lathe shears cut away, *E* is an eccentric, with a throw of ½ inch, thus giving a 1-inch stroke, the sheaf of which is turned solid on the boss of the faceplate *F*; *G* is a rectangular steel bar 1x⅜ inch, coupled up to *E* by the bolt *H*; *I* is a rocking lever of similar section to *G*, with a boss *K* forged solid on it. This is bored out to slot on the steel shaft *L*. The shaft is supported by the two bearing brackets *M* and *N*; *J* is a ⅜-inch bolt, which couples the connecting rod *G* up to the rocking lever *I*; *C* is an adjustable rocking lever similar to *I*, which couples up to the rod *P*, shown in Fig. 6; *P* is coupled up to the lever *Q*, which has an arm *R* solid with it. This arm carries a swinging pawl *S*, which engages in the teeth of the pinion *T*. This slots on the end of the compound slide-rest feed screw, as shown in Fig. 5, which shows the arrangement of the slide when operating on a plug.

When the cut gets to the end, the pawl *S* is turned over by hand, and this reverses the direction of the feed instantly, so that it is not necessary to turn the rest back by hand to start afresh.



LATHE ATTACHMENT FOR TURNING TAPERS

We have used these taper-turning motions some years now, and have found them quite satisfactory in every way, and we could not wish for anything better. They do not cost much to make, and turn out accurate work, which is the main feature of work of this description.

Manchester, Eng. GARLAND COCKLE.

A Problem in Stresses

Regarding the problem first proposed by I. G. Norman on page 662, Vol. 32, Part 1, and again referred to by him on page 749, I offer the following suggestions.

Referring to the illustrations which appeared with Mr. Norman's first statement and using his same letters as symbols, let us first consider the conditions of stress which would exist if the heads *B* were removed while the pressure within *A* is maintained as indicated in Fig. 1. The total internal pressure on a segment of width *F*, Figs. 2 and 3, is called *W*, and this would be transmitted through the material by means of a shearing action to the section *C C*, Fig. 1, where it would tend to produce a uniform tension over the whole section.

At the same time this pressure *W* would also produce a bending action on the section *C C*, since the material would in effect be in the condition of a cantilever beam, as explained by Mr. Norman. To find the moment at *C C* we must first determine the center of gravity of the pressure *W*. This would not be exactly at the center of the distance *E*, as assumed by Mr. Norman, but would be slightly outside of the mid-point of *E*, on account of the trapezoidal-shaped area, as shown between *F* and *f*, Fig. 3. Furthermore, the lever arm of the force *W* is not $\frac{E}{2}$, as taken by Mr. Norman, but should be the distance from the center of the force to the neutral axis of the section, which is as shown in Fig. 3 a distance *x* beyond the end of the dimension *E*. The effect of this bending moment is to produce a tension at the inner edge of the section and a compression at the outer edge. The maximum fiber stress due to this moment is found as stated, by dividing the amount of the moment by the section modulus *S*, of the section *C C*. This result added to the result previously found by assuming *W* to be uniformly distributed over the section, gives the maximum stress at the inner edge of the section due to the forces so far considered.

Before going further we should note the effect upon the position of the point H, produced by the force W that we have been considering. The two opposite sides of the ring will be slightly separated from each other on account of the bending of the cantilever-shaped curved sides under the action of the internal pressure W. The amount of the movement may be so small as to be quite imperceptible, but still we know that it is perfectly definite in amount, and in fact it is the basis for the theory by which we have calculated the internal stresses so far. Moreover, at the point H where the head B is fastened to the ring the surface of contact will be tilted or bent outward by the distortion we have already considered, so that instead of lying in a plane it will be slightly conical in shape.

Now regarding the head by itself, the pressure acting against it will also tend to bulge it at its center. The more rigid it is, the less it will be distorted and the more nearly its surface of contact with the ring at H will remain a perfect plane. Still, however rigid it is made, we can think of an absolutely plane surface at H as only an ideal limit which may be approached but not reached. But the exact shape of the surface at H is of great importance in determining the effect of the head B upon the stresses in the ring. If the head B were sufficiently flexible so that its contact surface would take exactly the same conical shape as the surface of the ring when bulged outward by the forces acting upon it, then the internal pressure on the plate, called W_1 in amount by Mr. Norman, acting at the point H, would have exactly the effect on the ring calculated by him, except for the slight variation necessary in taking the moments around the neutral axis instead of the inner edge of the surface C.

If, however, the head at H has a contact surface more nearly a plane than the ring has, the head will have an important strengthening effect upon the ring. When the free end of a cantilever beam is not prevented from moving or deflecting sideways, but *is* prevented from becoming tipped or inclined through an angle, and is forced to maintain a direction exactly parallel to its original direction, it is called in Merriman's treatise on Mechanics of Materials, a cantilever with constraint, and is what Mr. Myers referred to as a cantilever with one end free but guided. The complete discussion of such a case would occupy too much space to be taken up here, and it may suffice to say that the effect of such constraint or guiding of the free end is to support or strengthen the cantilever beam and to reduce the amount of the moment at the fixed end $C\,C$, by a quantity which varies according to the distribution of the forces in operation. This reduction may vary between one-half and one-third of the total moment at the fixed end for forces placed like those arising in this problem.

Since the head B is a ribbed circular plate anchored at its edges, the calculation of its distortion under a lateral pressure is one of the most difficult problems in the mechanics of materials. In this case the plate seems to be made so rigid that in determining its strengthening effect upon the ring we may assume, without appreciable error, that the contact surface H is maintained rigidly plane in shape. Then we are justified in taking the bending moment at $C\,C$ as only two-thirds of the value that would otherwise be calculated as due to the forces W and W_1. Under the given conditions, this is a conservative assumption and on the safe side.

In conclusion, therefore, the maximum fiber stress in $C\,C$ would be the sum of the stress due to the moment produced by W and W_1, derived as explained above, and the stress caused by W and W_1 when distributed uniformly over the whole section. A complete calculation can be made, of course, only when numerical quantities are fully given.

Iowa City, Iowa. S. M. WOODWARD.

In reply to Mr. Norman's criticism, at page 749, of my solution to his problem in stresses which appeared at page 1075, part 1, 1909, will say that in Fig. 2, page 1075, the dimension l_1 is improperly given. It was intended to give l_1 in such a manner as to equal $\frac{1}{2}(d+t)$, in other words it is the distance between the lines $g\,g$ and $S'\,S'$. As formerly pointed out the circular form has the effect of guiding the free end f of the cantilever, thus reducing the effective lever arm of the force from

$$l_1 \text{ to } \tfrac{1}{2}\ l_1 = \tfrac{1}{4}\ (d+t).$$

This is the only effect the circular form has upon the bending stress and if we substitute the above in equation (8) we have

$$S_b = \frac{3\,(d+t)\,p\,D\,d}{4\,D_1\,t^2}.$$

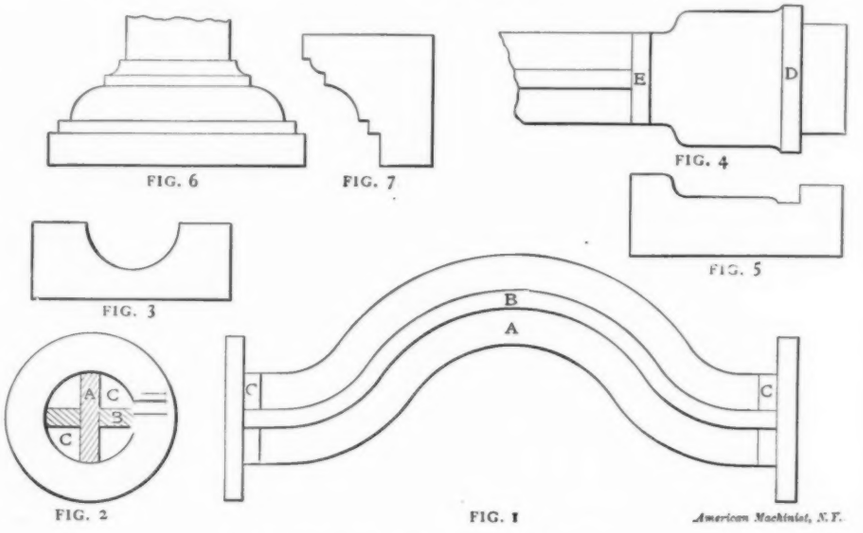
In Fig. 3 the dimension D_3 is not given; D_3 is the inside diameter of the flange and is equal to $D_2 - 2l_2$. Again, at page 1076, fourth line from top, the word movement should be read moment. If Mr. Norman will make these corrections in the article and then read it over carefully I believe he will find it correct and due allowance to have been made for the circular form.

Philadelphia, Penn. JOHN S. MEYERS.

Pipe Patterns for Single Castings

As an old pipe hand I was much interested in the article on Page 404 on "Pipe Patterns for Single Castings" and think that the following methods of making them which were adopted in a foundry where I was at one time employed may interest some of your readers.

The advantages claimed were: The castings turned out more regular in thickness; that is free from swellings, lumps and flats, such as are often found on castings made from skeleton patterns; also, a great saving was effected in the molder's time without adding to the cost of the patternmaking. When as often happened two or three castings were required the saving was proportionally greater.



PIPE PATTERNS FOR SINGLE CASTINGS

Fig. 1 shows the construction of a bend by this method. A templet A is made to the required form just as for a skeleton pattern; next the ribs B of suitable depth to extend to the outside of the pipe, as shown in section in Fig. 2, are attached and segments C to make the complete round are fixed at the ends.

A strickle as shown in Fig. 3 is next cut to the outside diameter of the pipe; the skeleton fixed temporarily to a bench with dogs or brads and the uppermost side swept up with plaster of paris. It is then turned over and the other side similarly treated. A few nails driven in at various angles, and left projecting so that the plaster will run round them, hold it securely after it hardens. It will be noticed

that the edges of the templet *A* and the ribs *B* act as guides for the strickle.

The timber used in the construction of these patterns was always the cheapest obtainable, and if required over about 9 inches in width the templet and ribs were made in several pieces with broken joints, one acting as the batten for the other.

In Fig. 4 is shown how a gland is swept on a pipe; Fig. 5 being the strickle. It runs on the two segments *D* and *E*.

In Fig. 6 is shown a neck that is molding on a column head and swept up in a similar manner with the strickle shown in Fig. 7.

Of course, this method is only suitable when only a few castings are required and the columns are of fair sized dimensions, but it effects a saving in both time and material.

Edinburgh, Scotland. ROBERT FAITE.

Who Can Tell the Commercial Effect of Odors?

Replying to Osborne's odoriferous contribution on page 856 I think I can set his mind at ease about the names of several of the odors which annoy and please him. The stuff used with bronze powder is banana oil. It certainly is not pleasant in large quantities. I can't account for the headaches except perhaps that they are caused by effect of the smell on the nerves. There is another product which smells like bananas, nitrite of amyl; at least that's the way the name sounds although the spelling may be incorrect. Two or three sniffs of this chemical cause the blood to flow to the head and the result is a violent headache. This was the poison said to have been used in the case of Rice who was murdered in New York some years ago.

The odor from the paper comes from the "coating" on "coated paper" only, I think. It is due to the glue or size used to finish the surface. It is not a necessary adjunct (I mean the stink) as there is at least one coated paper which is without it.

A great many of the cup greases are made with so-called "horse" oil as a base. No! horse oil cannot be made from cowslips; the odor is so different. The manufacturers generally scent the mixture with tincture or oil of myrrhbane (the spelling in this case may also be wrong). This oil has a very pleasant odor and, as the old woman said when she spat off the cliff, "a little goes a long way," two or three drops will scent several pounds of horse oil.

An experience of mine relative to the effect of an odor may be of interest. Years ago I was a marine engineer but in 1892 I quit the sea and for eleven years never took any more lengthy voyage than across the ferry or an occasional trip up or down the Delaware, all in smooth water. In 1903 I decided to go across the Atlantic for a visit and sailed as passenger on the Cunard liner "Umbria." The "Umbria" is well known for her ability to roll under favorable conditions. As soon as we got outside we had a fresh wind and moderately heavy sea from the starboard quarter. Few ships can resist this combination and the old "Umbria" did herself proud, with the result that after two hours of her combined rolling and pitching I was ready to part with the remains of a very excellent steak which had cost me 75 cents ashore. My stomach rebelled at the steak and my thrifty Scotch blood rebelled at the idea of losing even the residue of a 75-cent purchase. I was torn betwixt love of comfort and the pride of an old shellback not wishing to be seen making an oblation to Neptune in public. To divert my attention from my troubles I stuck my head in under the open engine-room skylights. The old-time engine-room smells, hot cylinder oil and tallow, wafted (wafted sounds good) on the rising currents of heated air from the stifling depths below, entered my nostrils. I closed my eyes and in an instant stepped backward a dozen years. I was in the engine room; over there on the port bulkhead I could plainly see the steam and vacuum gages, while I noted the water sliding lazily up and down in the gage glasses, showing through the openings in the forward bulkhead. When I opened my eyes a moment later, the feeling of nausea was gone and it did not return for the rest of that voyage. Four years later I had occasion to try the same remedy and it worked.

New York. E. A. DIXIE.

German Mechanics

In a recent issue of the AMERICAN MACHINIST "Artist Artisan" describes a lock key which he had made in the German shop; and by which he would have us judge the work of German mechanics.

My father was a "Schlosser" over there, some thirty years ago. He has often told me of the time when he was "Auf der Wanderschaft" in Germany, Austria, Hungary and Switzerland. He sometimes spoke of having been employed by a firm which was then, as now, a leader in the German mechanical industry.

I wish our friend could have seen some of the work my father did in the land of the "Pickelhaube" half a lifetime ago, or some which he has done since then; I wish he could have seen some of the splendid work which I have seen, done by German mechanics in this country. Then I would like to show him a "job" which carries in conspicuous places the brass nameplates of a leading manufacturer of America; or tell him about the unsuccessful attempt to "put over" on those who ordered it, some thousands of dollars worth of work, all "nicely fixed." Or of other "Bulls" that were born in the shops of preëminent America.

I think "Artist Artisan" would put his poor little key (which, being a very insignificant job, was probably given to the apprentice to make) away and discontinue its use as an example of the kind of work German mechanics are doing today.

Chicago, Ill. ARTHUR F. KUNZE.

[We can get a worse job than the key shown around the corner from this office. Good work and bad work is done in every country. All the nutmegs in Connecticut are not made of wood nor all the beef in Chicago embalmed.—EDITOR.]

What is Action of a Lubricant or Coolant on a Turning Tool?

I read with great interest the article in the AMERICAN MACHINIST, page 335, about the action of a lubricant or coolant on a turning tool. I think that metallography could give A. H. A. the best answer on this question. This science, which shows the structure of metals and the effects on them from mechanical strains would also explain in what manner a turning tool is removing chips with or without the different lubricants. I therefore suggest making a number of turning tests with several metals, as wrought iron, steel, cast iron, bronze, aluminum, etc. With each of these metals at the least eight tests should be performed.

1. With a new tool:
   a. without a lubricant or coolant.
   b. with water.
   c. with ordinary oil.
   d. with a lubricant of great viscosity.
2. With a worn tool:
   a. b. c. d. as under 1.

The tests can be made on short pieces of cylindrical rods of the different metals and can be sent to a metallographical institute. There they will be cut just through the spot where the point of the turning tool stopped, and treated after the methods of metallography. The photographs of such sections, greatly enlarged by means of a microscope, will surely show the action of the tool under the different conditions, and will answer the questions whether there is a splitting or any other effect round the tool's point.

I should be exceedingly pleased to read again of this question in your paper.

CONRAD DEUTSCH.

Winterthur, Switzerland.

Dies for Forming Tubes

Referring to the article by A. B. Card, page 839, the usual way to make brass tubes such as described is as follows: Cut and draw in a double-acting press, anneal and redraw the shells. I should say two redraws would be sufficient. The last die should be 2 inches in diameter. We then have a straight shell 2 inches in

diameter and 2⅝ inches long. Make three stamping dies with steel forces and finish to shape under a drop hammer. It is possible that four stamping dies might be required but I think that three will be sufficient. Anneal for each stamping if necessary. Trim the large end in the lathe and cut off the small end in the same manner, but in another operation. The foregoing method is practised by all the larger brass manufacturing factories and is a cheap, effective method.

Taunton, Mass. E. VERD.

Electric Driving of Shops

The contribution by "Du Pont" on page 486, raises a very interesting question around which a great amount of argument has taken place. Personally speaking, I have had a fair experience on both the individual driving of machine tools and also group driving for machine shops.

In the case of a machine shop having all its tools converted to individual motor drive I have found that the aggregate brake horsepower of the motors equals approximately twice that of the horsepower of the engine previously employed. When a shop is converted on the group-driving system the similar aggregate comes out at about 1⅓ to 1½ times that of the engine, depending on the size of groups.

Du Pont gives suggestions as to why the increase of power is required and as far as he goes I think he is quite correct. To start with the engine he says rarely indicates more than 52 horsepower. Most likely when an extra heavy load has been on this power may have been increased 25 per cent. I have known of many cases where a safety valve has been extra weighted because the engine was not holding up to its work. The flywheel of the engine is mentioned as being very heavy so this would, of course, give out as much energy as would be enough to make even a 50-brake-horsepower motor suffer.

To obtain an idea as to where the power is being used, consider the individual machines which I approximate as shown in the following table:

No. Off.	Machine Particulars.	Horsepower. Maximum Power at Tool Point. S.	Horsepower. Average Power at Tool Point. S.	Horsepower. Power to Run Machine Light.
2	Planers, 12 feet per minute	7	4½	1½ (¾ each)
5	Planers, 18 feet per minute	25	15	6½ (1¼ each)
1	Hot saw	8½	2	1½
1	Bending rolls	1½	¾	¾
2	Emery wheels	8	2	2
1	Grindstone	Flywheel effect		2
16	Radial drills	12	4	8
2	Drills	1½	¾	1

In machine, total = 28½ + 22 = 50½ horsepower
Power for driving shafting = 12 horsepower
62½ horsepower

But of the 62½ horsepower 34 horsepower is used in driving the shafting and machines; this leaves only 28½ horsepower for actual useful work, which is about 45 per cent.

I have looked up several records of machine-shop driving and find that for medium shops using shafting from 2½-inch diameter to 3½-inch diameter, the aggregate horsepower varies from 9 to 12 per 100 feet; slotting machines, drills and small lathes being on the low side, and planers, milling machines, etc., on the high side.

As regards the power consumption after conversion to electric group drive, since double the power was substituted and then overloading still took place it is pretty evident that the individual motor powers were not chosen correctly.

For driving the two emery wheels and hot saw I think it would have been advisable to group these three and drive them with a 16-horsepower compound-wound motor with flywheel instead of having two 10-horsepower motors as indicated. Another 16-horsepower motor of the shunt-wound type, without flywheel, should be quite adequate for the 16 radial drills.

With reference to the planers the two 30-horsepower motors should be quite enough for same; it is quite possible that the one driving the group of four planers would be overloaded occasionally, but neither of sufficient overload or for long enough time to cause any trouble with a good motor.

No information is given as to the type of motor used. They should be compound-wound and fitted with fairly heavy flywheels. The compounding should allow of a drop in speed of about 7½ per cent. Most likely the motors in question were ordered simply for driving line shafting and no further information given, in which case they would be supplied with a shunt-wound motor.

Du Pont informs us that the planers were speeded up, allowing for the increased speeds as given; we have as a total for the "three" groups, that is, Nos. 2, 3, and 4, the following:

$$(5+5)\tfrac{7}{4\frac{1}{2}} + (1\tfrac{1}{4} \times 2 \times \tfrac{25}{4\frac{1}{2}}) + (3\tfrac{1}{2} \times \tfrac{15}{4\frac{1}{2}}) + \tfrac{8}{4} \times \tfrac{1\frac{1}{2}}{4\frac{1}{2}} = 23$$

horsepower maximum; without line shafting, which would not be more than three horsepower. The total maximum power of the four-planer group by the same method would be 29 horsepower + 3 horsepower for line shaft.

Du Pont remarks on the decrease in length of shafting and practically says that this should help to save money. He does not, however, take into account the extra increase of pressure on the bearings due to the increased belt pulls; this latter may possibly account for a good deal of the trouble. Before alteration the shafting and bearings had been proved by practice to be suitable for transmitting 50 horsepower, but afterward when 110 horsepower was used, the size of the bearings would most probably be on the low side, in which case the cross-sectional area film of oil would not be great enough to support the load and hence it would get partially squeezed out; this might easily increase the coefficient of friction by 30 per cent.

Sheffield, England. A. M. B.

Inventing and Patenting

Mr. Knipe's criticism, on page 843, would carry more weight were it based on knowledge rather than on assumption. All corporations do not have the same equipment, and what equipment they possess is usually a matter of evolution and growth. It was my fortune to experience some of the effects of such development and, consequently, to learn something of patent practice and costs under conditions entirely devoid of such advantages as he describes, at a time when our company's patent procedure was about as closely akin to that of the individual applicant as may be conceived.

A fruitful source of cost is lack of intelligent procedure, rather than any inherent conditions. It is impossible to secure something for nothing even in securing a patent. The inventor must expend not only money for his patent, but careful thought as well. As has been previously indicated, too many, actuated perhaps by a belief that in paying an attorney his fee they are paying for clairvoyant service, impart inadequate information that results in useless work and extra cost. Discussion with attorneys has emphasized the fact that it is extremely difficult at times to secure complete data; an outline is given and much is left to the imagination and skill of the attorney to complete the detail. One of several cases brought to my attention is in point, where a patent application was brought to the point of allowance, when it was discovered that both drawings and specification contained a vital error. The attorneys who had prepared and prosecuted the application are well known, careful and diligent. The matter was one that the inventor should have seen, but his only excuse was that he thought the patent lawyer knew his business and, therefore, did not pay much attention either to the application which he signed, or the communications that were sent to him. Anyone who has tried to build a device or machine under such

perfunctory auspices knows the usual result.

One attorney of large experience put the matter in this way: "We not only prepare the necessary papers but in many cases we practically have to invent as well."

That which interests me is the fact that there is a legitimate field of invention which is full of opportunities, of which advantage may be taken by exercise of the same quality and degree of care as must be exercised in other fields of effort. If there are pitfalls they are not more numerous than in other fields, and my observations lead me to believe the defects are more in the individuals who are hurrying helter skelter to pick the biggest berries, or cull the largest nuggets—thereby running amuck—than in the field itself.

Central Falls, R. I. E. C. SMITH.

Jerry Wise and the Perfect System

I was more than glad to hear from brother Jerry, on page 808; very glad indeed until I read that he woke up. If he had only had a few, just a very few, workmen flitting around in the dark, giving the castings an occasional friendly boost, why just possibly he might not have awakened and the family finances would have improved. You see this trying to get along without any men is something like the Irishman's horse that we used to read about in our Greek history, the one for which he mixed sawdust and corn in gradually increasing proportions until it was all sawdust.

Of course, we all understand that what seriously interferes with unlimited reduction of costs is human nature, which implies the attached human being. Eliminate the human and you get, well you get a lot of chances to bring him back into the game.

Now, I have a clock; it was a present some ten or a dozen years ago, so I ought not to look a gift horse in the mouth, but it has its peculiarities. In the first place, if you wind it up to the stop, it stops, and you have to run it by hand power for an hour and a half to run it down enough to free itself so that it will go by its own motive power. Then, too, it won't run at all except on a cushion. It stood perfectly motionless for a couple of years before I found that out. I used to try to start it every six months or so; finally I set it on the dining-room table where we have a thick pad, and it ran nicely. I set it back on the shelf and it stopped. Then I caught on to its little game and put a holder such as Mrs. Wise uses in the kitchen under it, and it has run all right ever since.

You see where Jerry was lame on his perfect system; he needed a few men of infinite patience scattered around the shop to straighten out the tendencies of castings to come crooked, and of drills to run out, and all such things. Possibly if he had been willing to charge up their cost to overhead expenses he could have persuaded his experts to let him have them about the shop. I notice that whatever they save in the shop they seem bound to spend in overhead charges.

I cannot help but wonder if Jerry collected his bills for advertising from the Norton Company before he woke up. That bit struck me as the neatest part of the whole scheme, but after all they tell me that grinding is only milling with something even better than high-speed steel for cutters. Even with his planers running 200 feet a minute you see he was a long way behind his milling machines, which he misnames grinders, running their cutters at 4000 feet. Better discard the planer, brother Jerry! It is an expensive, slow tool compared with a grinder.

Then there were the time cards. Of course, no well systematized firm could get along without time cards, but if there are no men then the machines certainly have to have them, probably dark-steel color instead of white for the men. This is where Jerry's systematizer fooled him, for in spite of his flying flock of time cards, no charges appear for the time of these individual machines. That would have cut some hundreds of dollars out of his profits, but still there would have been enough left so that the whole Wise family could knock off work for some time.

MEMORANDA, CLIPPINGS, ETC.

While we are on the subject of human nature I want to say a word about clippings, memoranda, bound volumes and index work in general. The greatest trouble with all these things is that usually the wrong things are indexed. Take a man who has become recently interested in gasolene engines. He looks back in his index, or his note book, or his clipping files, and he finds just exactly nothing about gasolene engines. Why? Just because all these last few years he had been interested in machine tools, and indexed almost nothing else.

One way out is to rely wholly on the professional indexers, as I call them, who index every article that appears in the leading journals that is given a place or a setting that makes the maker of the index think it is worth reading. The other is to either keep or to have access to all the periodicals likely to have articles on mechanical subjects, read them carefully and make mental note of whatever is of interest. Then 10 years later you may remember that you saw something on babbitting large bearings somewhere. Then you can take an evening off and read index after index of the papers until you find it. If you bear in mind that this is just as likely to be indexed under the L's as "large bearings, babbitting," as anywhere else you may find it.

As for me I prefer the professional index. Its only objection is its bulk, which is, of course, increasing so rapidly that it is fast escaping from the range of many a man's pocketbook. It can, however, be followed along one or more lines; for example, a man interested in machine tools can omit the indexes of mining, and a man interested in mining can omit almost everything else. It would be a good move to interest the public libraries in these complete indexes. They would be of more value to the public than half the money spent on fiction in equal sums.

Even these professional indexes do not touch the thousand and one little items of interest that only fill a paragraph. Sometimes those little five- or six-line paragraphs have a lot of meat in them, but I shall have to confess that I know of no other way than to remember them.

Springfield, Mass. CON WISE.

Testing Worm Wheels

At page 898, Volume 31, Part 1, is given a method of testing the accuracy of the worm wheels of universal dividing heads. I should be glad if the author of the article in question could inform me exactly how this method tests the accuracy of the wheel.

I take it that in testing such a wheel it is necessary to test the pitch of each tooth, whereas by the method given the only test made is whether each tooth is diametrically opposite to its corresponding tooth on the opposite side of the wheel. The test I employ is as follows: On an arbor placed in the spindle of the dividing head two plain flat disks of equal and as large a diameter as possible are tightly clamped. The dividing head is clamped on the table of the machine and a scriber held on the cutter arbor. Fine lines are then scribed or marked across the face of each disk for each tooth of the wheel, this being indexed in the usual manner. Afterward the two disks are revolved one on the other, and, of course, the lines on either disk should in any position correspond exactly with the lines on the other disk. By taking careful note of the markings as made, it is readily seen where the wheel is at fault. I should be glad to hear of any other practical method of testing the pitch of wheel teeth with which your readers may be acquainted.

London, England. A. C. WILD.

A warning to those who are prone to walk railroad tracks is given by the *Engineering News* in the following statement: Notwithstanding all that is being done by American railways to rid their lines of trespassers, the deaths among those walking on the track steadily increase. In 1898 the number of trespassers killed on American railways was 4063; in 1907 the number was 5612—more than 15 persons killed for every day in the year.

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Industrial Accidents and the Insurance Question

The question of industrial accidents is never a pleasant one, but it is always with us and seems to be coming more and more to the front in nearly all parts of the country. The manufacturers as a whole have been put in rather a bad light with the public at large, owing to the actions of a few of the very large corporations, where men are killed and maimed at an astonishing and heart-rending rate. True, they are often ignorant Poles or Huns, with little of what we call civilization, yet they are human beings. In fact, it is a common saying in some quarters that if horses were killed or injured as fast as the men, there would be a way found to stop it. The horses would mean a direct loss of perhaps two hundred dollars each while the men have no money value of that kind to the corporation.

This does not mean that the heads of these large corporations are heartless or that they have none of the finer sensibilities of the rest of us. On the contrary, many of them are men of known tenderness and generosity when their personal side is touched. The trouble is that in most cases they do not get close enough to the real workers to recognize or think of them as human beings at all.

We doubt very much if the real heads realize or consider to what length some of their attorneys or agents go in cases of this kind, as it does not seem credible that they would countenance it if it was fully understood. In the city of Buffalo for instance, we are informed that no inquest is required unless asked for, and we know of a case where it took considerable effort to secure an inquest in a case where the worker was killed without the slightest chance of escape while doing his duty at his appointed task. The company refused to even pay funeral expenses but finally had to pay several thousand dollars after an appealed suit.

Among the worst sinners in this respect are some of the so-called liability companies whose attorneys are too often guilty of the worst kind of browbeating of bereaved women at a time when their senses are numbed with grief and the bread winner has been killed at his work, often by a preventable accident.

It is common talk, which may or may not be correct, that in an emergency hospital in a certain large city, even the doctors are in league with these attorneys and actually prevent injured men from seeing their friends to make any statement before they die, and of assisting in the browbeating tactics if they recover.

These are unpleasant statements and we do not for a moment believe the tactics employed or any attempt at unfairness, meets the approval of manufacturers in general. Machine-tool builders are doing more and more each day to make their tools safer to run as can be seen from the ever-increasing guards on gears and other dangerous parts. But these occurrences react on them as well as others and should be carefully considered by them.

While many accidents are preventable by guards on machines and care on the part of the operator, there seem to be some which are not, and it seems hardly fair that the workman should be expected to bear all the burden of the money loss as well as the suffering and possibly permanent disability. In fact there are some shops, both large and small, which pay all doctor bills as well as full wages while the worker is incapacitated. They look upon it as one of the overhead charges of the business as well as from the humanitarian point of view. And it can hardly fail to create a feeling of coöperation between the men and the company that makes for better things on both sides.

There is no doubt as to the awakening of interest in the use of safeguards in shops as shown by both the National Metal Trades Association and the National Machine Tool Builders, writing Dr. Tolman, of the Bureau of Safety Appliances, to address them. And the next logical step seems to be the introduction of some sort of an accident insurance, which will give every employee a reasonable remuneration for accident or the family for death, instead of the present system which breeds shyster lawyers and other unpleasant consequences. Can anyone doubt the different attitude of the men, and of the effect on the work that would result from a fellow worker being fairly treated or from his being shown no consideration whatever?

Such compensation or insurance would be treated in the same way as fire or other insurance and become a fixed charge on the overhead or burden of a shop. And we very much doubt if it would cost much more in the long run, than the present system, which retains its more or less unscrupulous lawyers, some of whom (if what appear to be authentic reports be true), are not above pocketing part of the money which, small as it is, is really supposed to go to the injured or his family.

It is interesting to note that one of the large insurance companies, noted for its progressiveness and fair dealings, is working along this same line, issuing a blanket policy for shops of different sizes, so that the machinery for such a course is already in operation. We believe it only requires a little careful thought on the part of manufacturers to see the advantages of some better plan than we now have, which makes enemies where it should retain friends.

Drilling Small Holes in Large Work

An observer cannot fail to be impressed with the apparent lack of attention to such work as drilling small holes in comparatively large castings. Of course, radial drills have been developed until they are much more convenient in every way and have speed and feed changes almost without number, yet the drilling of a ¼-inch hole on a large radial seems decidedly out of place in many ways.

The swinging of a ponderous arm stiff enough to resist the strain imposed by a 2-inch drill, the driving of the gear train in the head at its highest speed, with the attendant power consumption, and wear, all seem out of keeping with our development along other lines. There is little fault to find with radial drills of the present day for the larger sizes of work for which they are designed; the trouble comes from using them for small drills, as seems to be necessary in many cases. Of the work recently observed in a number of shops, the drills used did not often run much over ½ inch, yet the large machine was used, on account of its reach, for ease in getting at the various portions of the work.

Something has already been done in a few instances toward the development of a light radial drilling machine, and in many shops, special machines can be found which are the result of this need. A case in mind is the drilling and tapping of automobile work, cases where the holes rarely run larger than a ¾-inch tap and where a high-speed, open belt drive will give ample power, especially if a geared tapping attachment is used.

Probably the most difficult feature of the proposition is to get an arm which will be stiff enough to resist the upward thrust, and yet be light enough to be easily handled. The spindle drive can be handled with little difficulty by a high-speed belt in the older types of radial drills.

We believe there is a real need for machines of this type, of perhaps wider range of action than those now offered in this line, bearing in mind that they are for small drills only, and getting away from the idea of making a machine to cover such a wide range of drill sizes as at present.

New Publications

DISSERTATION AND COMMENT ON COSTS. By Ray W. Long. 29 3x5¼-inch pages. Ray W. Long, Pittsfield, Mass.

This is a little paper-covered booklet presenting some of the fundamental ideas in cost accounting. From its size it will be truthfully inferred that the treatment is by means of a series of hints, not by extended discussion. The section headings are: Organization; Departmentization; Productive Costs, Material; Productive Costs, Labor; Overhead Expense; Random Shots; Summary.

MECHANICAL DRAWING FOR TRADE SCHOOLS. MACHINERY TRADES EDITION. By Chas. C. Leeds. Text and plates for fifty-eight lessons; pages, 8x10½ inches, oblong. D. Van Nostrand Company. New York City. Price, $2 net.

This treatise is the outgrowth of the author's experience as assistant to Head of School for Apprentices and Journeymen, Carnegie Technical Schools, and the lessons have been arranged in a manner which he feels will attract and hold the attention of the student, the object being to illustrate with each lesson some fundamental point in mechanical drawing and thus carry the student forward by a series of easy steps. The lessons, as a rule, are arranged with the text in concise form on the left-hand page, the plates forming the subject of the lesson occupying the facing page to the right. Lessons on the care and use of instruments, lettering, sketching, tracing, etc., are followed by practical applications, projections, sectioning, drawing to scale, simple assembly drawings. Other lessons take up geometrical problems, curves, conic sections, intersections, the laying out of spur, bevel and worm gearing. Ten lessons are devoted to details of a 12-inch speed lathe, and others relate to bench-grinder details, details of electrical apparatus, the laying out of cams, structural drawings, riveted joints, standard framing, etc.

KRITIK DER DRAIHENFLIEGEN. By Ansbert Vorreiter. 120 5½x8½-inch pages; 101 illustrations in the text; Richard Carl Schmidt & Co., Berlin.

Owing to the increased interest in aviation in Europe, it is but natural that books dealing with the subject should be brought out there, although our own language is lean on this subject. The book under review is the first volume of an extensive library projected by the author on the broad subject of aëronautics. It deals entirely with aëroplanes, describes and illustrates all of the well known machines, and many not so well known. Its treatment is somewhat popular and elementary and there is little technical material in it. At the same time we are glad to welcome it for it shows the beginnings of the technical literature of aviation.

HANDY MAN'S WORKSHOP AND LABORATORY. A. Russell Bond. 467 6x8½-inch pages; 370 illustrations; indexed. Munn & Co., Inc., New York City. Price, $2.

This book is the outgrowth of a department opened about a year ago in the *Scientific American* and devoted to the handy man. It comprises a collection of kinks, hints, ingenious ideas and useful bits of information dealing with mechanical work about the house or as followed for a pastime. Thus it is for the boy with a mechanical bent and amateur mechanic. There are nine chapters with these headings: Fitting up a Workshop; Shop Kinks; The Soldering of Metals; The Handy Man in the Factory; The Handy Man's Experimental Laboratory; The Handy Man's Electrical Laboratory; The Handy Man About the House; The Handy Sportsman; Model Toy Flying Machines.

Obituary

F. L. Gallagher, secretary and treasurer of the Modern Tool Company, Erie, Penn., died very suddenly on November 29. Mr. Gallagher was but 41 years old.

William Metcalf, for many years an eminent figure in the steel industry, died at his home in Pittsburg, December 5, aged 71. Besides an acknowledged authority in the manufacture of steel, Mr. Metcalf was a broad-gaged engineer, having served a term as president of the American Society of Civil Engineers as well as having similarly been honored in the American Institute of Mining Engineers. He was also a member of the American Society of Mechanical Engineers and the American Iron and Steel Association, having acted in both in the capacity of vice-president.

Personals*

Charles Kirchhoff, editor of the *Iron Age*, and for nearly 30 years employed in its service, has relinquished his post, announcing his retirement from active business.

William Conant, for a number of years foreman in the employ of the Torrey Roller Bushing Company, Bath, Maine, has established a silver-plating plant at Phippsburg, Maine.

Max Rother, buyer of American products for the German office of Schuchardt & Schütte, arrived here on December 4. Mr. Rother expects to remain in this country about three months.

William Hayse, formerly connected with the Charlestown navy yard, in the department of ordnance, has recently been appointed expert aide at the Naval Torpedo station, Newport, R. I.

Paul W. Chamberlain has opened an office at 1522 Marquette building, Chicago, Ill., and will carry on a consulting engineer's practice. Mr. Chamberlain is a Cornell graduate of 1890, since which time he has had a wide practical experience.

F. E. Snow, treasurer and director of Wells Brothers' Company, Greenfield, Mass., has retired from an active part in the management of that business. Edward Blake, Jr., manager of the sales department and closely associated with Mr. Snow, has been made a director of the company.

*Items for this column are solicited.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make it Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

Automobile Cam Shaft Grinding Machine

The accompanying illustrations show a highly interesting attachment to the Norton grinding machine for grinding the valve cams of automobile engines, a sample of work in which the cams are integral with the shaft, being shown in Fig. 1.

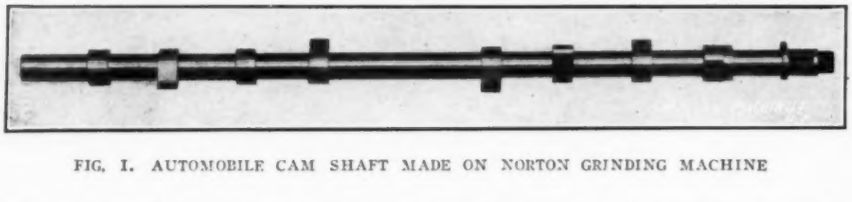


FIG. 1. AUTOMOBILE CAM SHAFT MADE ON NORTON GRINDING MACHINE

A general view of the attachment is shown in Fig. 2, by which it will be seen that the shaft to be ground and a series of leader cams for controlling the movement are mounted in a swinging frame, carried by brackets which are bolted to the machine. Fig. 3 shows the left-hand end of the attachment with the cover of the leader cams turned back and from it a better idea of the operation of the device will be obtained.

The Indexing Arrangement

It will be seen that there is a complete set of leader cams, four inlet and four exhaust, which are so arranged as to eliminate the possibility of errors in their selection when doing the grinding. They are arranged in the same numerical order as the cams to be ground; the guide roller is mounted in a movable arm, with an index rod and pin plainly seen in the foreground, and the index holes are numbered to correspond with the cams to be ground, the arrangement being such that for grinding the first cam the pin is placed in the first index hole while for the second cam it is placed in the second hole, and so on to the end. A spring contained in the case plainly shown at the left maintains contact between the master cams and the roller, while a releasing lever at the extreme left of Fig. 3, but shown better in Fig. 2, provides for separating the cams and roller when the change from cam to cam is made. The operation of the machine is thus of the simplest possible character, while its product is well nigh perfection.

Making the Leader Cams

The reader will naturally ask how the leader cams are made and this question will be answered by reference to Fig. 4. The forms of these cams do not depend upon hand layout. On the contrary, they are made by a strictly mechanical and precision process to the same degree that the making of the working cams is a precision process. In their production the operation of the machine is reversed—the automobile maker supplying a pair of sample cams which, during the process, become master cams for the production of the working leader cams. The grinding wheel is removed from the machine and in its place is substituted a piece of steel turned to the diameter of the wheel and mounted as shown in the illustration. The guide roller, shown in Fig. 3, is removed and in its place is substituted a grinding wheel, which is accurately dressed by means of a micrometer to the same diameter as the guide roller, while a small motor

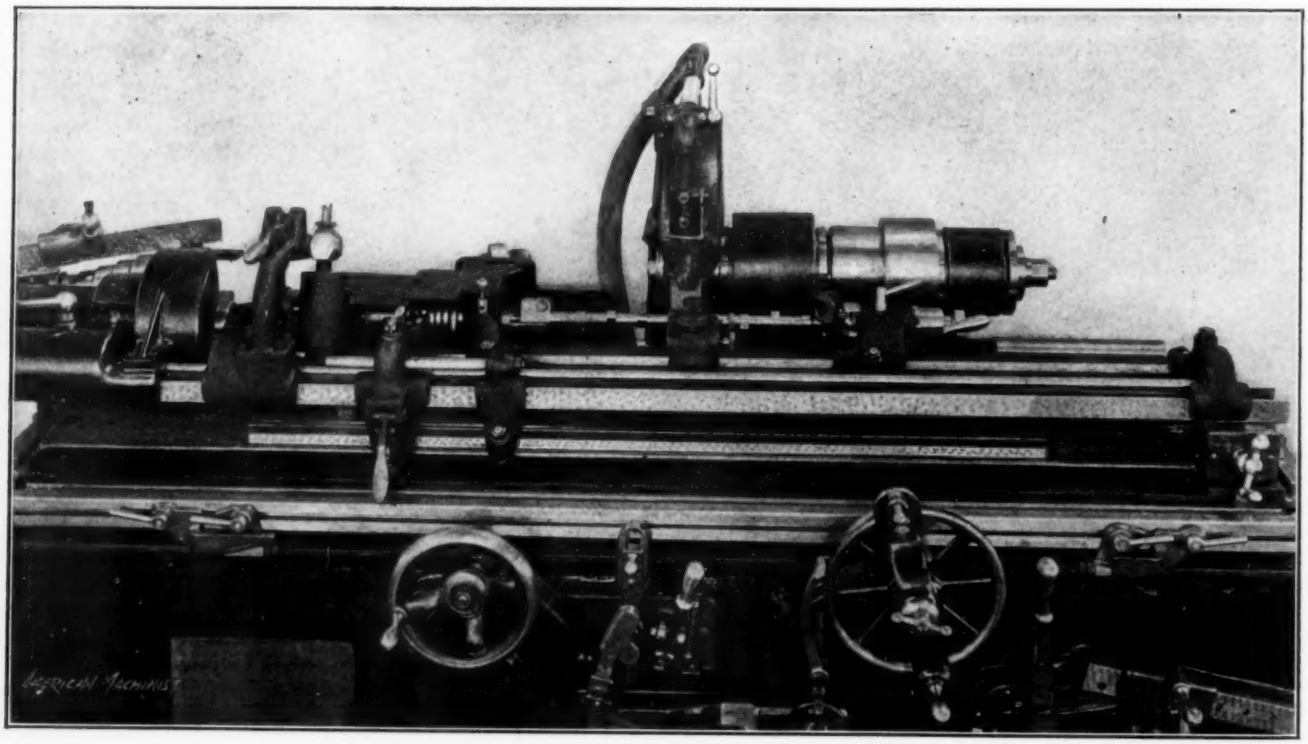


FIG. 2. NORTON INTEGRAL CAM-GRINDING ATTACHMENT

is mounted upon the machine for driving it as clearly shown. Inasmuch as the controlling spring referred to in the description of Fig. 3 acts to draw the leader cams toward the guide roller—an action the reverse of that which is desired for the present purpose—a spring which acts in the opposite direction is substituted for it as shown in Fig. 4, this spring acting to maintain contact between the manufacturer's sample and the iron guide as is obviously necessary. The cams to be formed are first roughed out in a milling attachment not shown and then mounted in the manner shown in Fig. 4. The machine being placed in operation it is obvious that the manufacturers' sample cams so control the movement as to produce the correct shapes in the leader cams being ground, albeit, because of their increased diameter over the samples, this shape is very different from that of the samples.

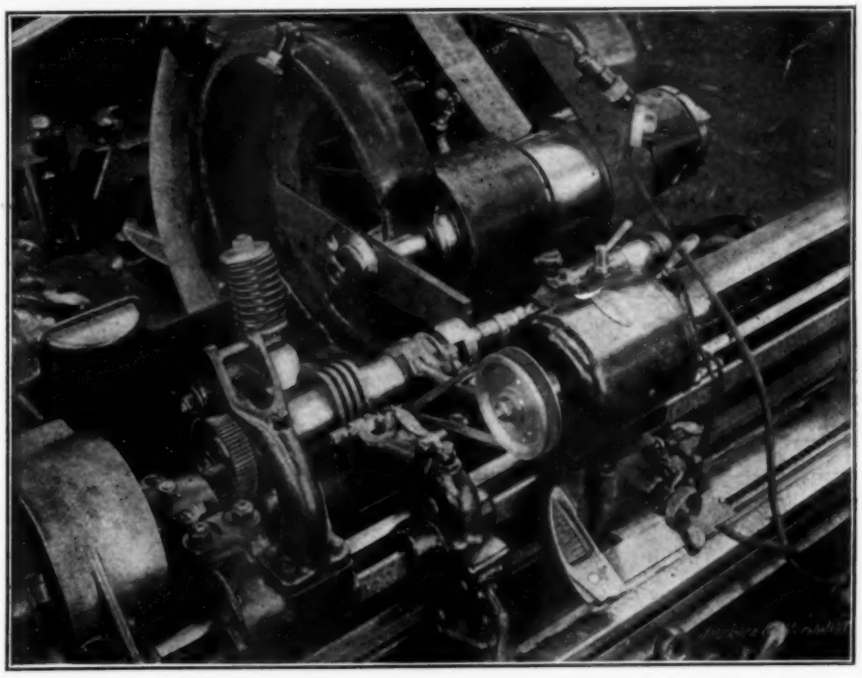


FIG. 4. ATTACHMENT REVERSED IN ACTION FOR THE MAKING OF THE GUIDE CAMS

Assembling the Leader Cams

The entire set of four inlet or four exhaust cams, as the case may be, is produced at a single setting, following which the other set is produced in the same way and it only remains to assemble them properly in order to have the correct outfit shown in Fig. 3. For this purpose four splines are cut so that the cams may be assembled upon their shafts in four positions at 90 degrees apart and after the cams are made it only remains to string them upon the shaft with proper regard to the splines used in each case and to the order of firing used in the engine for which the cams are made, in order to have the permanent outfit shown in Fig. 3.

It will be seen that the entire process, back from the manufacturer's sample cams through the leader working cams to the final product is strictly mechanical and of as high a degree of precision as is possible in grinding work of any character.

It will be observed that the same outfit may be used for grinding the square shafts used in connection with automobile change gears, with the result that such shafts are produced in a manner strictly analogous with that by which ordinary round work is ground and with the same certainty of straightness and concentricity.

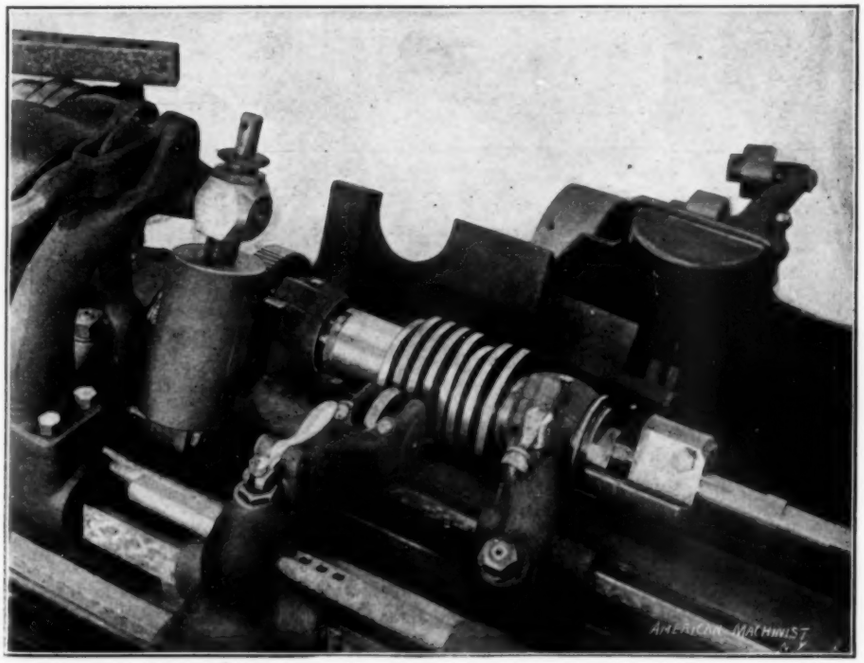
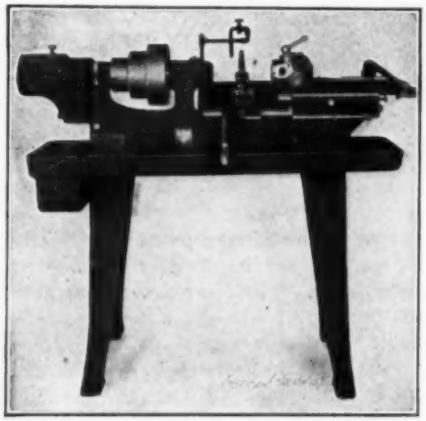


FIG. 3. GUIDE CAMS AND OTHER PARTS OF NORTON CAM-GRINDING ATTACHMENT

A Small Tilted Turret

The Wood Turret Machine Company, Brazil, Ind., is now making its tilted turrets in a ¾-inch size, as shown in the illustration. The general construction of the machine is very similar to the larger sizes, having automatic bar feed, automatic chucks, independent adjustable stops for each position of the turret, together with a simple provision for quickly setting the machine for non-indexing work. The turret slide is moved by a sector of a gear working in a rack on the slide itself. This gives a uniform leverage at all points instead of a varying leverage as in some designs. All revolving portions, except the



A SMALL TILTED-TURRET SCREW MACHINE

three-step cone, are carefully and neatly guarded, and an oil supply is provided as with the larger machines.

A New 36-inch Radial Drill

Simplicity in the driving mechanism has been one of the main objects in redesigning this radial. One pair of bevel gears is carried in the inside of the column thus obviating two spur gears, one shaft and two bearings. The frictional transmission arrangement of the power to the drill spindle from these bevel gears is the same as published in detail several years ago.

The elevating screw is placed in a recess shown in the rear of the worm-carrying feed rod. The quick return has four levers each engaging and disengaging the feed. The feed is of the all-geared type, having four changes which are varied by means of a ducking key in connection with the nurled shiftable knob on the worm rod. The spindle has an automatic stop and is graduated for depth. The rack is cleared at its extreme end to avoid breakage when used to the limit of travel.

A novel feature of the machine is the connection of the column-carrying stump, column and table, as seen in Fig. 2. The column fits into the stump and rests on rollers for easy movement. The table encircles the lower stump and a small part of the column and by depressing the

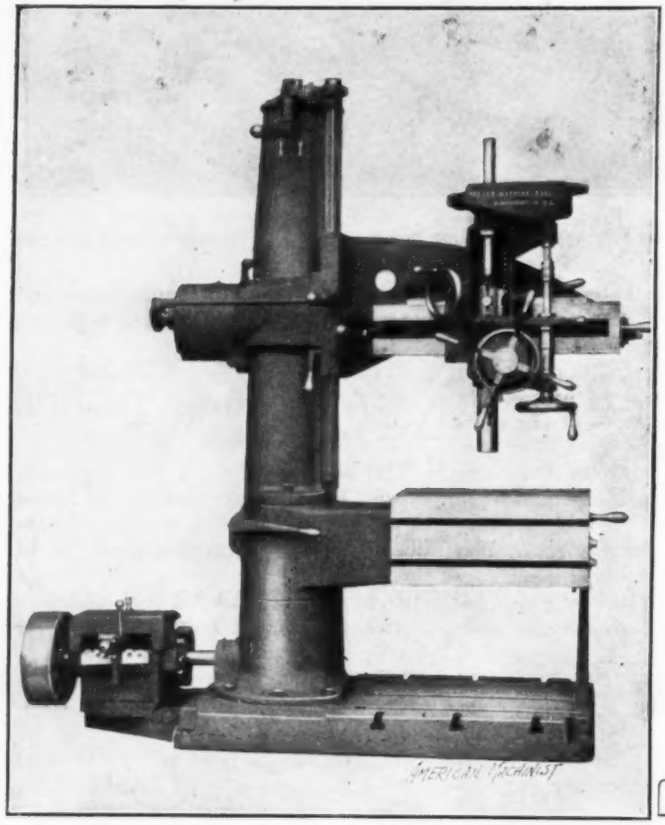


FIG. 1. NEW DRESES RADIAL

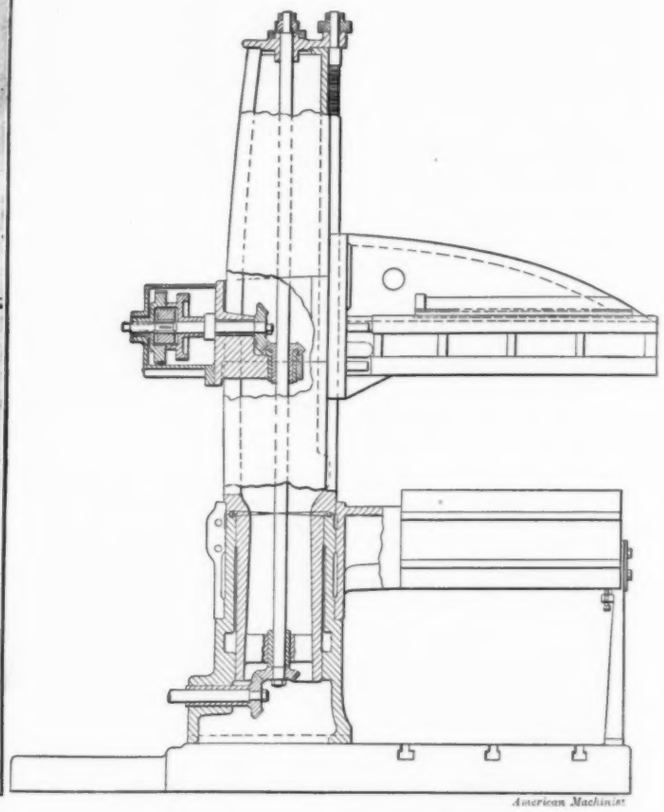


FIG. 2. HOW IT IS CONSTRUCTED

in front of the column protecting it from damage and not impairing the swing of the machine. The lever protruding near the column through the arm operates a double friction which starts, stops, engages the back gears and reverses the spindle for tapping all while the machine is running. The lever above sets the machine for tapping and also reverses the spindle at a ratio of 5:7, while the former lever reverses the spindle at a ratio of 1:4 forward and backward. A nurled screw on the main operating lever adjusts the gripping power of the driving friction clutch so taps will not tear off when striking the bottom of the hole.

The head is moved on the arm by a rack and spiral pinion and clamped by the lever lever shown in front, it binds, by means of a screw, all three substantially together. This lever is always in reach of the left hand of the operator without changing his position. A tension screw below the lever insures a working fit at all times.

The table is supported in front by a stand having an adjusting screw, so that it can always be kept at right angles with the spindle. The machine is also built with a cone drive and constant- and variable-speed motors are attached by means of a subbase. It drills to the center of a 73-inch circle, takes 58 inches readily under the spindle and weighs about 3600 pounds. It is made by the Dreses Machine Tool Company, Cincinnati, O.

Sets of Taper Pin Reamers

The Cleveland Twist Drill Company, Cleveland, O., is putting up standard taper pin reamers in sizes from 0 to 5, in a round wooden box, very convenient for the machine shop or automobile garage. The box is two inches in diameter by five inches high and makes a safe and handy place to keep them. The set is known as their No. 30.

National Die Sharpener

The die sharpener illustrated at page 969, part 2, present volume, is being manufactured by the National Machinery Company, Tiffin, Ohio, as a complete machine with stand, and is not placed on the market as a bench grinder, as might be imagined from the illustration, which was used to show only the head.

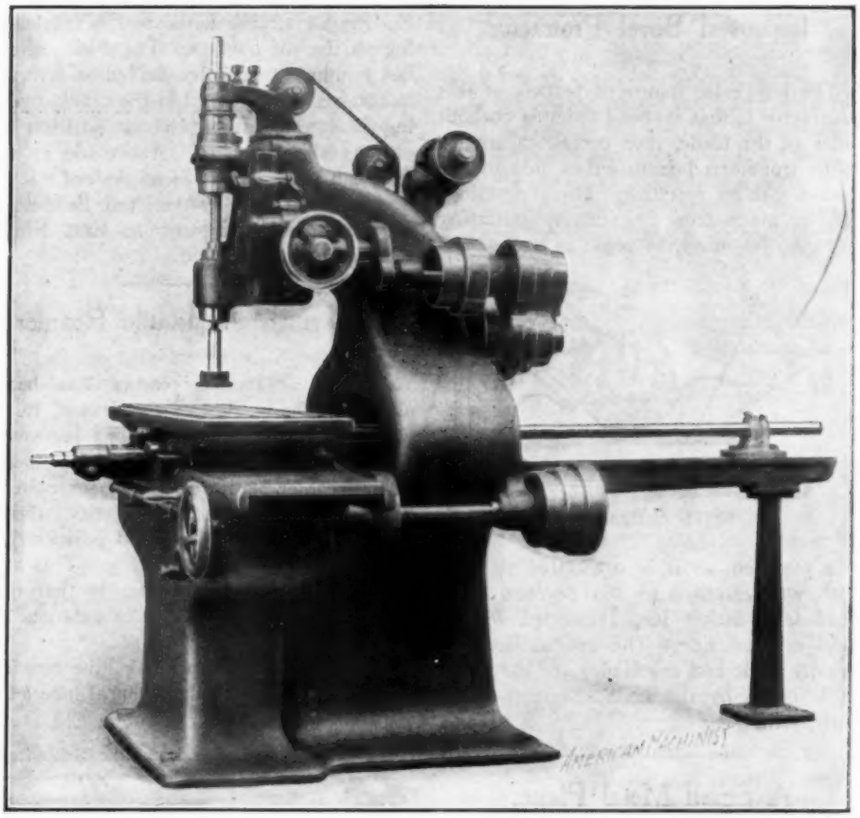
Improvements in Drill Press

The Frontier Iron Works, successors to the Robertson Drill and Tool Company, Buffalo, N. Y., are now making their drill presses with the column in one piece instead of having the head separate and bolted to it as formerly. They have also increased the distance between the

spindle and the table 3½ inches to give more room between drill and table when using a chuck.

Vertical Grinder for Plain and Radius Work

The illustration shows a substantial grinding machine, having a vertical spindle, which can be used either for plain surfacing work or for radius work such as locomotive links. An opening through the frame permits the passage of the radius rod and an extension at the back allows the fulcrum to be moved to any desired point. This radius rod is attached to the grinding table and controls its movement across the main slide which gives it its motion for plain grinding, and allows any desired radius to be ground within the capacity of the machine. The spindle is carried in an adjustable head and supported both sides of the driving pulley. This is made by the Société Alsacienne of the Constructions Mecaniques of Grafenstaden, Alsace.



GRINDING MACHINE FOR PLAIN AND RADIUS WORK

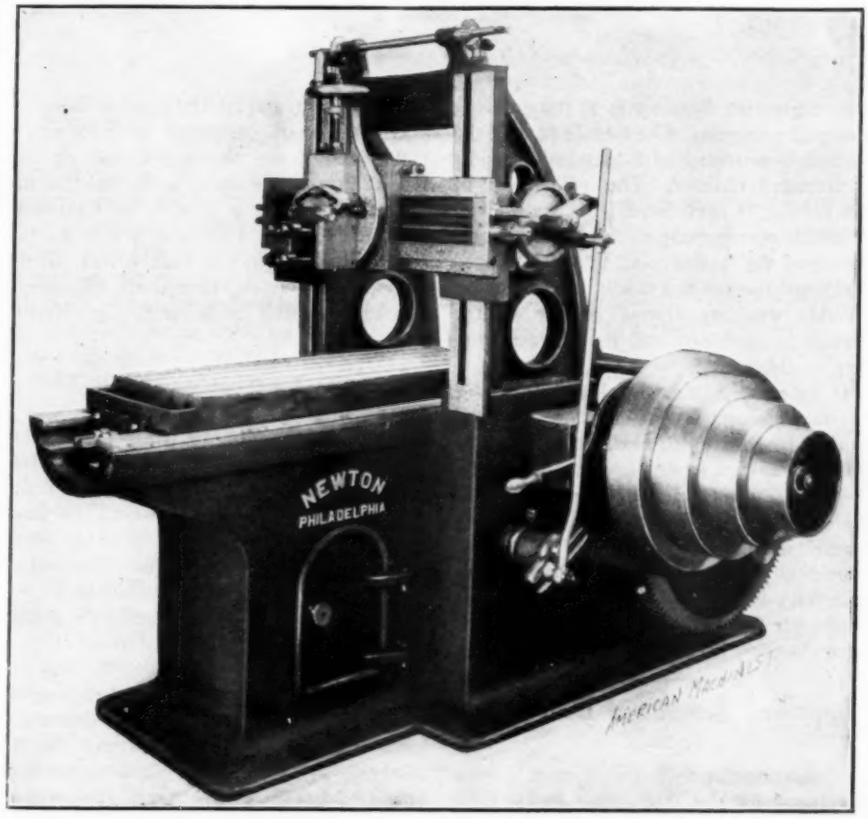
New Design Crank Planing Machine

This machine is designed for machining irregular-shaped parts in quantities, more particularly steel castings and similar work where it is desirable to take heavy cuts and coarse feeds. It is aimed to eliminate chatter and to take advantage of the highest speeds for rapid production.

The cross rail of the machine is of comparatively heavy box-type construction gibbed to the uprights and has hand vertical adjustment. The tool apron is mounted in a clapper box giving substantial side support and a swiveling arrangement permits clearance of cutting tools. The saddle on the cross rail has square-locked gibbed bearings with taper shoes for compensating for wear and has reversing power feed and hand adjustment. Intermittent feed is obtained by a plate at the end of the stroke eliminating a constant jar on the cutting tools.

The work table is fitted to the bed of the machine with square-lock gibbed bearings, proper tension on the side adjustments being maintained by shoes. The stroke of the table can be adjusted to any desired length by a screw mounted in the crank plate as shown in the accompanying photograph. The face of this crank plate is fitted with steel plates having grooves into which corresponding tongues on the connecting-rod bushing fit to relieve the stroke-adjusting screw of strain when taking cuts. Three changes of belt speed are provided and the drive is through broad-face, coarse-pitch gears, Whitworth motion giving quick return to the stroke.

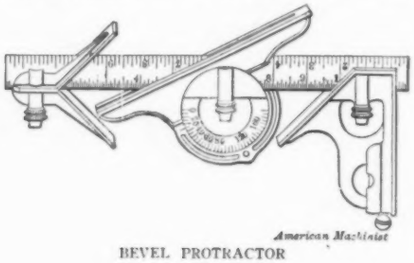
The machine has a length of stroke 24½-inch, table length over all is 46 inches, width of table and width between uprights being 16 inches and 21 inches, respectively. The hight under rail is 21 inches and the machine can be arranged for motor drive, alternating current or direct current. It is made by the Newton Machine Tool Works, Inc., Philadelphia, Penn.



NEW DESIGN CRANK-PLANING MACHINE

Improved Bevel Protractor

The important improved feature of this protractor is that its head extends on both sides of the blade, thus permitting angles to be transferred from either side of the frame without resetting. Direct readings can be made from the turret, indicating the supplement of the angle as well as the

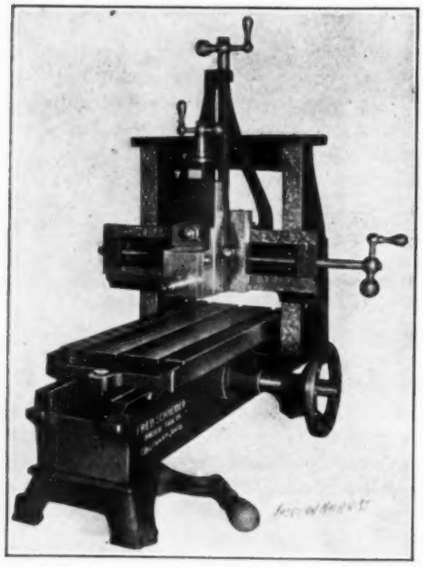


BEVEL PROTRACTOR

one required, as it is graduated to read both ways from 0 to 180 degrees. The head is 7 inches long, equipped with a level on one side. The graduations are heavily made and the blades are hardened. It is made by the L. S. Starrett Company, Athol, Mass.

A Small Metal Planer

This is a very substantial hand bench planer built especially for fine and heavy work within its range. It planes 10 inches between housings and 8½ inches under the



A SMALL METAL PLANER

cross-rail. The table is 18 inches inside the scrap pockets and the rack 24 inches long. The head work is the same design as in larger planers, long slide, and a dial on the down-feed screw. The cross-rail is elevated by the upper screw and the frame on the cross-rail. A bracket is mounted on top of the arch and enters the slot of the elevating frame, giving a substantial guide to the cross-rail. The bed has flat ways, and there are oilways leading to the oil pockets. The hand wheel has a number of holes drilled at its rim to receive a pin located in the crank, making it convenient to change position at various short strokes. Automatic cross-feed can be furnished if so desired. It is designed and built by the Fred. Schneider Machine Tool Company, 20 East Ninth street, Cincinnati, Ohio.

A German Adjustable Reamer

A new adjustable reamer has been placed on the market by the firm of Ludwig Loewe & Co., Berlin. The improvement consists in producing the adjustment of the reamer blades by one or more steel balls placed in its hollow interior; these balls are held in any desired position by the spring of the reamer body. This arrangement has an advantage in that the diameter of the reamer can be enlarged at any chosen point.

As the figures render plain, the reamer body *a* is provided with a conical hole *b b'*,

FIG. 2

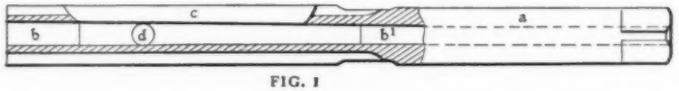


FIG. 1

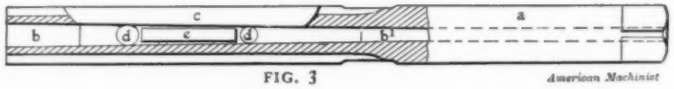


FIG. 3

American Machinist

A GERMAN ADJUSTABLE REAMER

whose greatest diameter is at the entering end of the reamer. The middle part of the reamer is provided with longitudinal slots *c*, arranged radially. The adjustment of the reamer is performed with a steel ball *d*, which corresponds to the largest diameter *b* of the hollow, and which is moved backward toward the shank of the reamer. In this way the slotted portion of the reamer is expanded, and its outside diameter is enlarged.

If only one ball be employed (see Fig. 1), the reamer has its greatest diameter at the place where the ball rests, since the hollow reamer ends, as shown in the drawing cannot expand along with the middle. If it be desired to expand the reamer not only at one point but along a considerable part of its length, several balls may be introduced into the hole and preferably held apart by short pieces of wire placed between them (see Fig. 3).

Improved Automatic Drill Drift

The automatic drill drift formerly manufactured by the Automatic Drill Drift Company, Springfield, Ill., and previously illustrated in these columns is now being solely manufactured by Armstrong Bros. Tool Company, Chicago, Ill.

The tool has been improved in design and character of materials used in its manufacture. A point of improvement is the insertion of a plug in the coiled spring which acts as a rammer and increases the area or surface on which the blow is struck.

The Annual Meeting of the American Society of Mechanical Engineers

The proceedings of the annual meeting of the American Society of Mechanical Engineers held in this city December 7 to 10, inclusive, included fewer papers of interest to the readers of the AMERICAN MACHINIST than usual, and in fact we recall no meeting at which the papers presented were of such limited interest to the circle which we represent as this one. Under these circumstances it seems unnecessary to present our usual abstract of each paper and of the discussion of it.

Of the papers presented but two, when considered from the standpoint of interest to our readers, seem entitled to notice, one being a Report on Cast-iron Test Bars, by A. F. Nagle, which we intend to reprint in the near future, while the second was on Line-shaft Efficiency, Mechanical and Economic, by Henry Hess.

LINE-SHAFT EFFICIENCY, MECHANICAL AND ECONOMIC

This paper opens by stating that the coefficient of friction of plain babbitted or cast-iron shaft bearings ranges from ½ of 1 per cent. to 8 per cent., and that a plant having a coefficient of 3 per cent. is one to be proud of. The remedy for this excessive friction is stated to lie in using ball-bearing hangers on line shafting.

A test conducted by Dodge & Day on a line of 27/16-inch shaft 72 feet long is described in detail, with the following general conclusions: The saving due to changing ten 27/16-inch plain ring-oiling babbitted bearings running at 214 revolutions per minute to ball bearings increases with increasing belt tension from

14 to 36 per cent. With the usual belt tensions of good practice ranging from 44 to 57 pounds per inch of width of single belt the saving amounts to 36 per cent. and 35 per cent.

The last paragraph of the paper presents a comparison between the use of ring-oiling and ball bearings on a dollars and cents basis. Here it is shown that taking electric current at a cost of 3 cents per kilowatt-hour for 3000 hours, the ball bearing returns a saving of 37 per cent. on the excess of their cost over the ring-oiling type.

The newly elected officers for the ensuing year are: George W. Westinghouse, president; George Whiting Baker, E. D. Meier, W. F. M. Goss, vice-presidents; J. Sellers Bancroft, James Hartness, H. G. Reist, managers; William H. Wiley, treasurer.

An Investigation of Strength of Crane Hooks

The paper on the strength of crane hooks by Professor Rautenstrauch on page 615 is certainly a very interesting and unusual treatment of this problem, and the comparison of the results obtained with the results given by the usual methods are so striking as to deserve very careful consideration.

I would call attention first to several apparent errors in the text. On page 616, in formula (11), f is omitted from the first term. A few lines further on, the equation of bending moments

$$W\rho_o = -\Sigma\,(f_y a + y_o)$$

I believe should be read

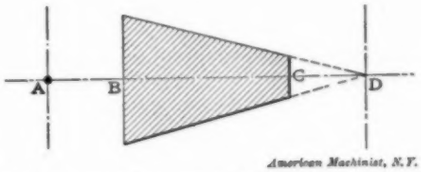
$$-\Sigma\,(f_y a\, y_o)$$

as expressing the equilibrium of moments. In formula (15) on the next page γ_2 should appear inversely instead of directly. On page 618, in the middle of the first column, the area $C\,Q\,E\,H\,A$ is referred to, which apparently should be $C\,G\,E\,H\,A$. I also note an apparent error of a decimal place in the value of γ_2 in the case of the 10-ton hook. Also in the formula over Fig. 9 $\frac{\rho_o}{1 \times n}$ should be $\frac{\rho_o}{1+n}$. It may be noted that the results by usual methods for the 30-ton hook, taking the data given, would be 2398 for the distributed stress and 12,224 for the bending stress, or 14,622 in place of 11,700 as given.

In regard to the analysis itself, the assumption, page 615, head of third column, that when stress occurs the plane moves parallel to itself, is not correct, but the analysis does not appear to depend on this assumption.

It is to be regretted that practically no dimensions of the hooks are given to enable the results to be checked by other methods. For instance, the depth of section is not given, although it is of extreme importance in determining the stress distribution. In fact, no data are given that would show that the failure under test did not occur at the compression edge rather than on the inner edge for which the results were calculated for comparison.

The deductions from this analysis, if accepted, indicate that the maximum stresses on a cross-section of a compact body with smooth regular contour and no abrupt change of shape or section, such as these crane hooks, may depend 60 per cent on conditions entirely outside of the section plane, such as the relations connecting that plane with those nearby on either side, and only to the extent of 40 per cent. or so on the conditions of stress on the section itself. In other words, the resultant of the combined stresses on any section cannot



American Machinist, N.Y.

FIG. 1. DIAGRAM OF TRAPEZOIDAL SECTION

be deduced with any accuracy from the simple combination of the principal stresses but is influenced to a greater extent by conditions external to that section. Such a result, applying to that great body of cases of combined stress making up the majority of stress calculations, is so entirely at variance with previously conceived and generally accepted ideas, that all data as to dimensions of the pieces tested ought to be given in detail to serve as an effective basis for checking the results by the old and new methods.

The difference between the old and the proposed methods appears to lie in the distribution of stress arising from the bending action. In the old method, at the

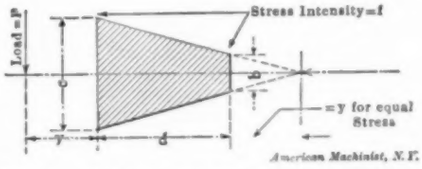


FIG. 2. DIAGRAM OF TRAPEZOIDAL SECTION AND NOTATION

center of gravity the bending stresses are considered zero, as at the neutral axis of a beam, and the uniformly distributed stress W/A acts alone. In the new method we have for the total stress at the center of gravity, from formula (12) multiplying by E.

$$E\lambda_B = f_B = \frac{W}{A} + \frac{W}{A}\left(\frac{1-\gamma_1}{\gamma_2}\right).$$

Now in those cases where $\gamma_1 = 1 + \gamma_2$, which is nearly true in all cases, judging from the properties of the sections described, we have

$$f_B = \frac{W}{A} + \frac{W}{A}\left(\frac{1-1-\gamma_2}{\gamma_2}\right) = \frac{W}{A} - \frac{W}{A} = 0$$

showing that there is at the gravity axis by this method, a compressive stress practically equal to the distributed tension stress, so that the resultant stress at this axis is nil, or nearly so. The displacement of the stress toward the tension edge as just shown means, of course, a "piling up" of the stress at the extreme edge.

Formula (15) is apparently intended to serve as the working formula and deserves special attention. The factor γ_2 as before mentioned should evidently appear inversely, and with this change the formula would give in effect

$$\frac{1}{\gamma_2}\left[\frac{1}{\left(1-\frac{d_t}{\rho_o}\right)^{1+n}} - \gamma_1\right]$$

or

$$\frac{1}{\gamma_2}\left[\left(\frac{\rho_o}{\rho_o - d_t}\right)^{1+n} - \gamma_1\right]$$

as the stress factor due to bending in place of the usual

$$\frac{\rho_o d_t}{\text{Radius gyration}^2}$$

or the distance ratio

$$\frac{\text{Edge to center of gravity}}{\text{Center of gravity to actual neutal axis}}$$

the actual neutral axis being at the mid depth for equal stress intensity, using the same notation as in the text, all being multiplied by the intensity of the distributed stress or W/A to give the fiber stress due to bending. It is evident from an examination of the section properties as given, that γ_1 is generally nearly 1, being very closely in each case equal to $1+\gamma_2$, and that γ_2 is equal and $1/\gamma_2$ large, in fact the most important factor in the equation. In the method given this factor is determined graphically from the difference in area of two curves derived from the section, and as such can scarcely be determined with the accuracy demanded by its important position in the formula.

Take for example the case of the 30-ton hook illustrated in detail. By formula (15)

$$f = \frac{W}{A}\left\{\frac{1}{\gamma_2}\left[\frac{1}{\left(1+\frac{d_t}{\rho_o}\right)^{1+n}} - \gamma_1\right] + 1\right\} =$$

$$2398 + \frac{2398}{0.08}\left[\left(\frac{7.25}{7.25-3.36}\right)^{\frac{1}{4}} - 1.089\right]$$

$$= 2398 + 2398 \times 12.3\,[2.169 - 1.089] =$$

$$2398\,(1 + 12.3 \times 1.080) =$$

$$2398\,(1 + 13.5) = 34{,}750.$$

This is given in detail to illustrate the supreme importance of the factor γ_2 and the extent of its influence on the result. It further shows that this formula gives in effect a combination of the usual direct distributed stress in combination with stresses due to bending so distributed as to give an extreme fiber stress more than twice as great as the distribution usually assumed, the figures in the above case being 13.5 to 6.1. An error in present methods as great as this, if it exists, is of vital importance in the calculation of stresses,

not only of crane hooks, but of many other forms of structure where similar conditions occur under combined stress. If the variation from the stress distribution usually assumed is due solely to the curvature of the piece and is not to be expected except when such curvature is present, the application is much simplified, and it may be possible to introduce into former methods some corrective factor depending on the curvature. If the "piling up" of the stress at the tension edge is controlled by the curvature, it would be possible to reduce it by making the inner contour of the hook elliptical, reducing thereby the radius of curvature at the critical section, and would apparently be avoided altogether if the back of the hook were made straight.

No note is made in the analysis of the curvature of the outer edge of the section, which is seldom concentric with the inner edge. If this new theory or conception of the influence of curvature is correct, it must be possible to explain in some clear and simpler manner just how the shape of the piece outside the section has such an enormous influence on the distribution of the stresses applied to the section itself.

How Are Formulas Applied to Original Designs?

It would be interesting to know just how Professor Rautenstrauch would apply these formulas to the original design of a hook or gap frame for direct solution, meeting assumed conditions. How would the factors γ_1 and γ_2 be determined in advance and how would a section be designed to meet these factors as determined?

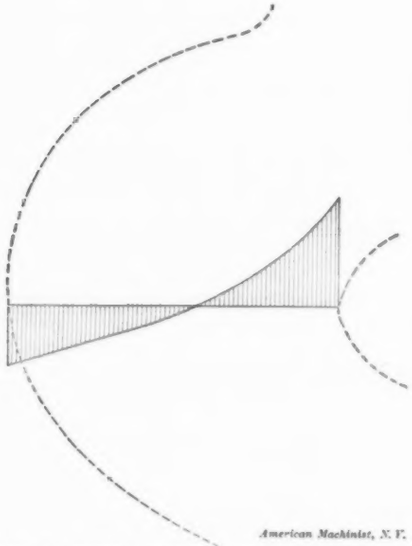


FIG. 3. STRESS DIAGRAM FOR HOOK PLOTTED FOR 15-TON WROUGHT-IRON HOOK FROM EQUATION (14) OF ORIGINAL ARTICLE

As no dimensions of the hooks are given it is impossible to say whether the hooks were designed for equal intensity of stress on both edges, referring now to the older methods of design. There is in this regard a property of the trapezoid section not commonly known, which is that for equal intensity of stress in the near and far edges when under combined stress, the sides should slope so that they intersect at a distance from the far, or narrow edge equal to the distance of the load line from the near edge.

Referring to Fig. 1, if we have a load acting along a line at A perpendicular to the paper and carried by a frame or hook having a trapezoid section $B\,C$, whose sides extended intersect at D, the intensities of stresses at B and C are equal if $A\,B$ is equal to $C\,D$. This can be shown by the usual assumptions of combined stress, and makes it possible to solve directly a problem relating to the design of such a section, assuming that the usual methods of calculating combined stress are correct.

Taking the quantities as shown in Fig. 2,

$$b\,d^2 = 6\,y\,\frac{F}{f}$$

where F = load and f = intensity of stress at either edge, from which

$$d = \sqrt[3]{6\,k\,y\,\frac{F}{f}}$$

where ratio $\frac{d}{b} = k$, a design factor. If it is desired to use a design factor involving the near or broad edge c in place of the narrow edge b, the formula is

$$c\,d_2 = 6\,(d + y)\,\frac{F}{f}.$$

This gives a cubic equation, and if the ratio $\frac{d}{c} = k$, we have approximately

$$d = \sqrt[3]{6\,k_1\,y\,\frac{F}{f}} + \frac{2\,k_1\,\frac{F}{f}}{\sqrt[3]{6\,k_1\,y\,\frac{F}{f}}}$$

giving a direct solution in either case. More complicated formulas can be derived for direct solution of such problems where the intensity of stresses is not equal, and for L and T shapes.

Somerville, Mass. E. J. Loring.

I thank Mr. Loring for calling the attention of the readers of the American Machinist to the corrections to be made in the article on the strength of crane hooks that it may read as originally composed. The theory proposed by Mr. Andrews is based on the proposition that there is no shearing stress over the section $A\,B\,C$ for which it is necessary to assume "the section after strain to remain plane." Fig. 3 is drawn to show the geometric relation between strained and unstrained "fibers." It is not intended to convey the idea that all "fibers" are equally stretched. The relations following show this so clearly that I deemed it unnecessary to call it to the attention of the readers. The figure had necessarily to be distorted.

It will be interesting to note in this connection the stress diagram for the section $A\,B\,C$. To this end I have prepared Fig. 3 from equation (14). In this equation, as it appears in the original article

$$\left(1 + \frac{y_o}{\rho_o}\right)$$

should be written for

$$\left(1 - \frac{y_o}{\rho_o}\right).$$

The distances in inches to the most strained point in compression called for in Mr. Loring's comments are as follows:

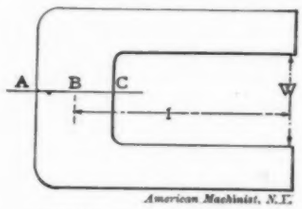


FIG. 4. DIAGRAM OF HOOK MEMBER WITH ROTATION

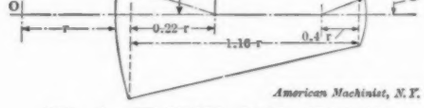


FIG. 5. STANDARD HOOK SECTION

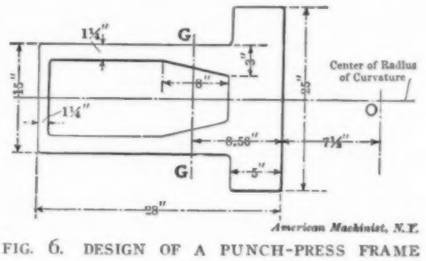


FIG. 6. DESIGN OF A PUNCH-PRESS FRAME
$A = 212$ $K = 68.56$ $P = 1.6$ $I = 14.533$
$J = 38.56$ $l = 8.56$.

Hook.	$d\,c$
30-ton steel	4.97
20-ton steel	4.07
15-ton steel	3.66
15-ton wrought iron	2.7
10-ton steel	3.00
10-ton wrought iron	2.25
5-ton steel	2.28
5-ton wrought iron	1.88
3-ton steel	1.73
2-ton steel	1.17

I cannot comprehend Mr. Loring's deduction that "the maximum stresses may depend 60 per cent. on conditions entirely outside of the section plane . . . . and only to the extent of 40 per cent. or so on the conditions of stress on the section itself."

It is a fact that when the radius of curvature is infinite such that the form of the member is as shown in Fig. 4 the expression for the maximum intensity of tensile stress reduces to

$$f_t = \frac{W}{A}\left(1 + \frac{l\,d_l}{r^2}\right)$$

where r is the radius of gyration of the section. The formula, therefore, appears to be rational. The radius of curvature used in this analysis is the radius of the line of centers of the successive cross-sections in this neighborhood. If the back edge of the hook is struck from a different center than the inner edge obviously the radius of curvature is not obtained by the simple addition of the inner radius to the distance from the gravity axis of the principal section to the most strain portion in tension. The modification necessary under this circumstance is obvious.

The application of these formulas to the original design of a book or any machine member of this form is the subject of a paper presented by me before the American Society of Mechanical Engineers at the November meeting. An abstract of this paper appears herewith.

In its present form it is a rather unwieldy instrument in the hands of a designer, but it may be made more applicable to design than might be thought at first. Upon examination it will be seen that the functions γ_1 and γ_2 are constants for all sections of similar form, that is, for all sections the proportions of which may be expressed as a function of some unit of dimension, for example, the radius of curvature. Under the same circumstances the entire expression within the brackets is a constant. The equation for a series of sizes and sections may, therefore, be written

$$ft = \frac{W}{A} K, \text{ or } A = \frac{W}{ft} K.$$

The area is a function of the unit squared and, therefore, we may write $A = C' r^2$, or

$$r = \sqrt{\frac{K}{C'}\frac{W}{ft}} = C\sqrt{\frac{W}{ft}}.$$

Applying this to the case of a series of hooks ranging from the minimum to the maximum to be manufactured, a standard form of section may be laid out as in Fig. 5, and the constant established. For the hooks tested by the writer the following values for the constant were found:

Hook.	Value of Constant.
30-ton, cast steel	3.00
30-ton, cast steel	3.10
15-ton, cast steel	3.23
15-ton, wrought iron	4.29
10-ton, cast steel	3.49
10-ton, wrought iron	3.42
5-ton, cast steel	3.12
5-ton, wrought iron	3.12
3-ton, cast steel	3.78
2-ton, cast steel	3.74
Average	3.43

To make the case representative of present practice let such ratio of proportions be assigned to the section shown in Fig. 5 that $C = 3.4$. The design of a series of wrought-iron hooks to sustain loads of from 2 to 40 tons with a limiting intensity of tensile stress of 30,000 pounds per square inch will require the following computations:

40-ton hook, $r = 3.4\sqrt{\frac{80,000}{30,000}} = 5.54$

30-ton hook, $r = 3.4\sqrt{\frac{60,000}{30,000}} = 4.7$

20-ton hook, $r = 3.4\sqrt{\frac{40,000}{30,000}} = 3.94$

10-ton hook, $r = 3.4\sqrt{\frac{20,000}{30,000}} = 2.76$

5-ton hood, $r = 3.4\sqrt{\frac{10,000}{30,000}} = 1.95$

2-ton hook, $r = 3.4\sqrt{\frac{4,000}{30,000}} = 1.23$

The proportions obtained above will be for loads giving a maximum stress at the elastic limit of the material. For cast steel different values will necessarily be obtained. The establishment of such a standard would lead to a very simple process for the determination of the principal section of a hook for any capacity; the proportions of the shank and other parts of the hook may readily be established on the same basis. The bottom of the hook, being subjected to much wear, cannot, of course, be proportioned on the basis of the stress analysis. The above standard section selected as an average representative of present practice is not, however, the most economic form of section from the standpoint of equal maximum tensile and compressive stresses. It has been pointed out by Professor Pearson that a section with such proportions is approximately an isosceles triangle with a radius of curvature of 1.75 of the hight. The more nearly this form could be approached the less would be the weight of hook for the same capacity.

Professor Goodman[1] points out that for hook sections the functions γ_1 and γ_2 are expressed approximately as follows:

$$\gamma_2 = \frac{k e}{1.2\,\rho^2}$$

$$\gamma_1 = 1 + 1.1\,\gamma_2$$

where k = radius of gyration of the sections, the other symbols being as before noted.

It will be found much more convenient to use these empirical expressions, which give quite accurate results, than to determine the value of the functions by the more tedious graphic method.

In applying these empirical formula to punch- and riveter-frame sections the writer has found that the results are not accurate, but that the values are better expressed as follows:

$$\gamma_2 = \frac{ke}{0.7\,\rho}$$

$$\gamma_1 = 1 + 1.1\,\gamma_2.$$

For example, consider the design for a punch frame shown in Fig. 6. Computing the values for the functions γ_1 and γ_2 by the graphic method, $\gamma_1 = 1.4$, $\gamma_2 = 0.405$. Whereupon the intensity of stress according to the new method of analysis for a force of 90,000 pounds at the punch will be

$$ft = \frac{W}{A}\left\{\frac{l}{\rho\,\gamma_2}\left(\frac{1}{\left(1-\frac{c}{\rho}\right)^{\frac{3}{4}}} - \gamma_1\right) + 1\right\} =$$

8500 pounds per square inch.

The values of γ_1 and γ_2 by the empirical formula are 1.44 and 0.4, respectively. Whereupon the intensity of stress becomes $ft = 8500$, approximately. According to the old formula used almost exclusively in textbooks, the value of ft is expressed by

$$\frac{W}{A} + \frac{W\,l\,e}{I},$$

whence $ft = 2450$.

The above empirical formulas are derived from the results of computation of two sections. I am not prepared to state that it will work out in all cases and must, therefore, caution anyone against using these values to check the results by the graphic method. It may be clearly seen that were the punch in question designed for a limiting intensity of stress of 2450 by the old formula, there would actually be a maximum stress of 8500 pounds per square inch, which is hardly a safe value for cast iron and particularly for a large casting.

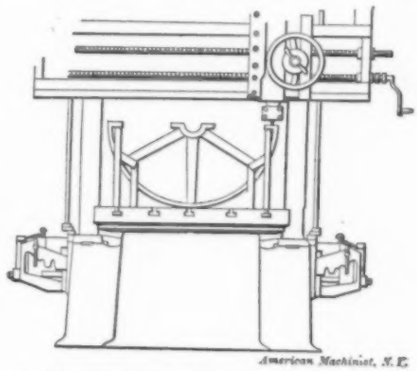
New York. W. RAUTENSTRAUCH.

A Planing Job on the Boring Mill

BY JOHN VAN PELT

It ofttimes happens that a job becomes difficult owing to the fact that the shop is not properly equipped.

The shop decided to take an order for an extra heavy 12-foot split pulley with planed joints. The large boring mill was to do the planing as well as the turning and boring. The pulley was cast in halves.



A PLANING JOB ON THE BORING MILL

Each half was placed on the boring mill as shown in the cut and the difficult operation of machining the joints was done in reasonable time.

After the joints were surfaced off and the pulley was drilled and bolted together the turning and boring were done on the same machine.

What is the Action of a Lubricant or Coolant?

By A. W. Adams

Sometimes the easiest way to work out a satisfactory answer to a problem is to sit down and lay it before some other fellow and then before he gets a chance at it you can often tell him what, why and when. I hope my somewhat positive critic on page 628 will pardon me if I now proceed to answer my own question.

First, however, since he hit me first, I want to hit back and ask whether he is not confusing two issues when comparing the action of a file "biting" the surface of a piece and the action of a lathe tool splitting off a chip from 1/64 inch to ¼ inch thick. In the one case the points of the tool are trying to enter, "bite," into a *surface*, and the lower the friction between the tool points and the surface the more difficult it is to make them enter or "bite." It seems to me "bite" is right in this case. But I am talking of tools with their teeth in—tools that are through "biting" and are "chewing;" tools with a heavier pressure above them than below. It would be a strange result to find that the nearer we could get oil or soda water to the cutting edge the greater power we should require to take a given cut.

It is just the reverse, and the reason I am convinced of the superiority of lard oil over any other known substance of reasonable price for turning mild steel at high speeds is, that for its body, that is, for the *strength* of its film (which has nothing to do with its adhesiveness to any particular metal or with its thickness) it is by far the least viscous; that is, the *thinnest* commercial oil known. This property allows it to be drawn into the most minute crevices and openings and the strength of its film is sufficient to be of service when it does reach the spot.

Mr. Haithwaite's statement that a thin oil forms a thin film is, in general, correct; though not his further statement that a thin film is (necessarily) "easily squeezed out" or broken through by pressure.

However, the theory of lubrication remains the same whether for cutting tools or bearings; I did not start out to discuss the elements of this theory but to explain how I believe the lubricant actually reaches the working point of the tool. The inference from the finish produced by use of a lubricant is irresistible that it *actually does reach the cutting* edge in minute quantities. This may be revolutionary, but I have given the thing a good deal of thought and find it impossible to believe that a lubricant applied on the turned surface *below* the cutting edge would have any smoothing effect.

Granting that the edge is not, microscopically considered, even when sharp a true *edge*, *E*, Fig. 1, but presents a certain rubbing surface *F*, in Fig. 2. It is impossible to conceive of any medium capable of creeping up *in* onto this rubbing surface *F* to a point where the pressure would be sufficient to do any smoothing or burnishing, as long as the continuous rapid downward passage of *new* surface of the work is maintained. The capillary pressure of any oil would not be sufficient to force it in between two surfaces pressed together with a burnishing pressure. Irregularities in the surfaces, if there was no relative motion, might allow the oil to get up in. A reciprocating movement would certainly work it up in, but with the work passing this surface *F* at a surface speed of 50 feet per minute, or even 25, the supposition that the oil finish is due to the oil creeping up in from below to a point where it can transform the seizing,

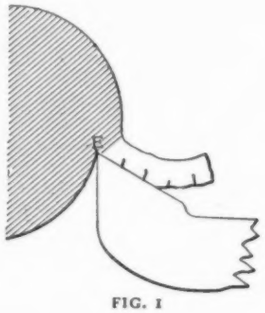


FIG. 1

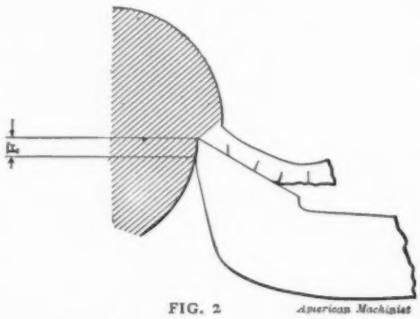


FIG. 2 American Machinist

DIAGRAMS OF CHIPS AND TOOLS

scratching, tearing surface *F* into a burnisher becomes absurd.

We are, therefore, *forced*, absolutely forced, if we like to remain logical, to assume that the oil gets to the edge *E*, or onto the surface *F* from above. This seems even more absurd than the "creeping up" theory, at first glance.

A careful reading of paragraphs 153 to 174 of F. W. Taylor's epoch-making paper "On the Art of Cutting Metals" (read before the American Society of Mechanical Engineers, in December, 1906), will undoubtedly give a clue to the action. The citation is too long for insertion here; moreover, every mechanic as well as every engineer should own a copy.

Other observers have noted this action as well. R. B., on page 789 of the American Machinist, cites some very interesting observations which tend to confirm my confidence in this theory. I am glad of his support, especially of the statement that chip fracture has been observed *in advance of the tool point.*

Assuming Mr. Taylor's diagram to be correct, however, in showing the first visible fracture as begun slightly back of the tool point, it is reasonable to suppose that the small portion of metal shown actually pressing down on the tip would, if faithfully reproduced on a scale much larger, show a cracking action exactly similar to that of the main or large chip, provided, of course, the tool point retained its keen edge. The opening of the most minute cracks would draw in the surrounding medium.

As a perhaps useful conclusion, then, I would state it as my belief that the harder the metal, that is, the less likely to stand distortion without cracking, the more viscous the oil that should be used and *vice versa.* As pertinent to this conclusion it is again mentioned that very malleable and "tough" metals; for example, copper and aluminum, and (though hardly a metal) hard rubber require the most fluid lubricants.

R. B. is certainly right in differentiating sharply between lathe, or turning, or boring of planing tools—edge continuously in the cut—and milling cutters, saws, etc.; where relays of edges do the work, each well lubricated before attacking the chip. I do not agree with his conclusions on brass, where I believe the action is similar to that on steel, and where *in order to get* the necessary cracks (as well as to prevent digging in of a poorly supported edge) the rake of a tool is usually nothing or negative. To support this I would return to my argument from oil finish on steel above and would apply the same reasoning to the brass. The difference is not as great, but there *is* a marked difference between the finish of a cut taken with and without oil, especially if the tool is not very keen and smooth. Moreover, for ordinary brass the very low viscosity and correspondingly weak-filmed oils, such as kerosene, also water, while much better cooling media, give poor results compared with lard oil or soap compounds. I, therefore, do not think with R. B. that it is a question of getting an oil that will penetrate, yet not disassociate due to heat, but of getting an oil that has low enough viscosity to penetrate and yet has the most "body;" that is, with the greatest ultimate strength of film. In this service oils that make fine lubricants for bearings where "perfect" lubrication (unbroken and comparatively thick film conditions) is possible, are of no use. The lubrication of cutting tools is imperfect lubrication. An unbroken film between tool and work seems impossible. For tool lubrication we want the thinnest oil obtainable—thin as benzine—with a film of the greatest strength. We want an oil of *very* low viscosity, which will still maintain an unbroken film between two flat surfaces

pressed together with a very great pressure.

I shall some day make an attempt to get graphite to the point of a tool. Probably I shall try the new electrically manufactured deflocculated graphite in a thin oil, such as kerosene. I am given to understand that this graphite is so fine that it will pass through filter paper. If this can be made to reach the right place it should resist the pressure much better than any oil. The same combination, if successful, would seem to me adapted for milling cutters and all intermittent as well as continuous tools. In other words, I shall have (if it works!) the ideal lubricant; as *thin* as possible, but resisting the maximum pressure. I wish some other dreamer would try this and report.

Forthcoming Meetings

American Society of Agricultural Engineers, third annual meeting, December 28-29, 1909, Ames, Ohio. F. W. Chase, secretary, University of Nebraska, Lincoln, Neb.

Business Items

After January 1, 1910, the address of C. Drucklieb will be changed from 132 Reade street to 178 Washington street.

Wm. J. Brewer Engineering Company, Troy, N. Y., is putting on the market an oilless, noiseless and frictionless bearing.

Business Opportunities

The Lehighton (Penn.) Lace Mill is erecting a new bleachery.

The Buffalo Cashmeter Company, Detroit, Mich., will build a foundry.

The Memphis (Tenn.) Bag Company will build a six-story factory.

The Abbott Motor Company, Detroit, Mich., is erecting a two-story factory.

The Port Arthur (Tex.) Traction Company is to erect a new power plant.

The Public Service Company, Passaic, N. J., will improve its power plant.

The North Wales (Penn.) Machine Company will erect a new plant.

The Reed City (Mich.) Veneer and Panel Company will build a new plant.

The Three Lakes Lumber Company, Snohomish, Wash., will erect an addition.

The F. C. Traver Paper Company, Chicago, Ill., has purchased site for a new plant.

The Brass Products Company, Southington, Conn., is adding a finishing department.

The Gould Balance Valve Company, Des Moines, Iowa, will erect a new plant.

The Inland Steel and Casting Company, Terre Haute, Ind., will enlarge its plant.

The Canton (Ohio) Buggy Company will engage in the manufacture of automobiles.

The American Type Founders Company, Jersey City, N. J., will erect an addition.

The St. Paul & Tacoma Lumber Company, Tacoma, Wash., will install an electric crane.

O. J. Shaw, of Aurora, Neb., has secured a franchise for an electric-light plant at Harvard, Neb.

Mershon, Bacon & Co., Bay City, Mich., are erecting a building for the manufacture of boxes.

Plans are being prepared for a repair shop for the Rome (N. Y.) Locomotive and Machine Works.

The plant of the Niantic (Conn.) Oil and Guano Company was burned. Loss, about $15,000.

The Emaus (Penn.) Foundry and Machine Company will, it is said, require additional equipment.

The Perry Sand Company, Buffalo, N. Y., require hoists, centrifugal pump and other equipment.

The Rogers Motor Car Company, Ralston, Neb., will soon let a contract for the construction of its plant.

The Wellknit Hosiery Company, Harrisburg, Penn., is contemplating the erection of another factory.

The plant of the Drew Carrier Company, Waterloo, Iowa, was destroyed by fire. Loss, about $40,000.

The Cincinnati (Ohio) Car Works has awarded contract for the construction of additional factory.

E. M. Schwartz & Co., New York, are building a new cigar factory at Eighty-first street and Avenue B.

The Grant & Lees Machine Company, Cleveland, Ohio, has commenced work on a new factory building.

The New Process Steel Company, Marshall, Mich., will enlarge a plant to five times its present capacity.

The Giles Boat and Engine Company, Ludington, Mich., is contemplating the erection of two additions.

The H. B. Drake Company, New York, manufacturing office furniture, will erect a plant in Bayonne, N. J.

The McFarland Foundry and Machine Company, Trenton, N. J., has awarded a contract for an addition to its plant.

The Egan Manufacturing Company, La Crosse, Wis., manufacturing potato diggers, will build an addition.

William Clohr Sons Company, Rising Sun, Ind., manufacturing farm implements, will locate in Washington, Ind.

The Otto Konigslow Manufacturing Company, Cleveland, Ohio, manufacturing metal stampings, will erect a new plant.

Plans have been completed for a new roundhouse at Santa Barbara, Cal., for the Southern Pacific Railroad.

The Powers-Weightman-Rosengarten Company, chemists, Philadelphia, Penn., is erecting an addition to its plant.

The Alabama, Tennessee & Northern Railroad will locate shops at Panola, Ala. William Toxey, Cochrane, Ala., chief engineer.

The Winters & Prophet Canning Company, Mt. Morris, N. Y., is erecting a building for the manufacture of tin cans.

The J. L. Clark Manufacturing Company, Rockford, Ill., making metal specialties, has bought site for a new plant.

W. S. Ducharme, of Johnstown, Penn., is forming a company for the purpose of manufacturing a patented wrench.

The Fort Wayne and Wabash Valley Traction Company will erect new car barns and repair shops at Lafayette, Ind.

G. A. Bisler, Inc., box manufacturer, will erect a five-story factory at 245-47 North Sixth street, Philadelphia, Penn.

The Louisiana Sash and Door Company, New Orleans, La., recently purchased a site for plant. The offices are at 922 Common street.

The Lehigh Manufacturing Company, Philadelphia, Penn., making lace goods, will erect an addition to cost about $500,000.

The Stafford Motor Car Company, of Topeka, Kan., will move to Kansas City, Mo., where a new plant will be erected.

The Waynesburg & Blacksville Street Railway Company, Waynesburg, Penn., is preparing plans for repair shops and a power house.

Palmer Bros., Cos Cob, Conn., building gasolene engines and launches, are erecting a new building. New equipment will be needed.

The Mutual Wheel Company, of Moline, Ill., will establish a plant at Paducah, Ky., for the manufacturing of wagon and buggy spokes.

The Huntington (Tenn.) Wood Manufacturing Company will establish a plant for the manufacture of boxes, crates and baskets at Hope, Ark.

The Leighton Machine Company, Manchester, N. H., will build a new shop in the spring to be equipped with new machinery.

The Superior Manufacturing Company, Hoosick Falls, N. Y., will erect a four-story addition. The company manufactures knit goods.

The Duroth Manufacturing Company, of Johnstown, Penn., will erect a plant in Seward, Penn., for the manufacture of brass castings.

The Spencer, Kellogg Company, of Buffalo, N. Y., manufacturer of linseed oil, will build a plant at Edgewater, N. J., to cost $550,000.

The National Spring Company, of St. Johns, N. B., will locate in Newcastle, Ind., where a plant for manufacturing automobile springs will be erected.

The Deyo Gas Engine Company, Binghamton, N. Y., whose plant was recently burned, will reconstruct the same and equip it with modern machinery.

The Oscar Lear Automobile Company, Springfield, Ohio, is in the market for a number of machine tools for machine shop and other departments.

The Oklahoma Gas Engine Company, Oklahoma City, Okla., organized with $30,000 capital, will erect a plant to cost $15,000. Arthur Fishbeck, president.

The A. H. Yocom Company, Reading, Penn., manufacturing gas engines, is erecting a new foundry for the production of iron, brass and aluminum castings.

The Birmingham (Ala.) Rail and Locomotive Company has purchased a site at North Birmingham on which a plant will be erected for the repair of railroad equipment.

The Iowa Central Railway has announced the preparation of plans for another addition to its shops at Marshalltown, Iowa, to be used for tin and tool shops.

The Riley-Klotz Manufacturing Company, Newark, N. J., whose plant was recently burned, will rebuild. The company manufactures metal novelties and automobile supplies.

The Leader Foundry and Machine Company, Quincy, Ill., is erecting a new plant. The company recently acquired the business of the Sharpe & Becker Machine Company.

The Wallace Manufacturing Company, Frankfort, Ind., manufacturing clay-working machinery, will make additions to its plant, including a new foundry building.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., December 23, for cast-steel shipper friction wheels, hacksaw blades, electrical attachments and wire.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: December 21—Hacksaw blades, steel bolts, twist drills, taper pin reamers, hand tools (schedule 2028); carbon twist drills (schedule 2024), medium steel (schedule 2030), 16-inch engine lathes (schedules 2019).

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

A first-class man with excellent record, systematic in modern manufacturing methods, invites correspondence in regards to position as superintendent or assistant. Box 997, AMERICAN MACHINIST.

Successful superintendent of experience in the manufacture of small parts for a complicated machine, capable of handling and carrying on systematic and orderly and economical production; now employed. Box 999, AM. MA.

MASSACHUSETTS

Experienced toolmaker and draftsman having had extended experience in charge of men and work; desires responsible position. Box 966, AMERICAN MACHINIST.

Wanted by an American man, 40 years old, who is an inventer and superintendent of a large machine shop and desiring a change; a position similar or foreman; have had 22 years' experience on die, tool and designing; will guarantee to cut out operations and reduce cost and get the best results out of help; best of references given. Box 992, AM. MA.

NEW JERSEY

Salesman—Machine tool salesman as sales manager, having 15 years' experience, both in the manufacture and selling of machine tools; competent judge of condition and value of second-hand, and familiar with all makes in the United States; can give best of reference. Box 790, AMERICAN MACHINIST.

NEW YORK

Jig fixture, gasolene engine, automobile designer wishes position. Box 998, AM. MACH.

Foreman machinist, tool and die maker, 20 years' experience in clocks and watch dies and tools, seeks position. Box 994, AM. MA.

Young man (25), experienced office man and designer, desires position for January 1; references. Box 996, AMERICAN MACHINIST.

Young man, 19, desires position as tracer and assistant draftsman; can furnish A-1 references as to accuracy and neatness. Box 5, AMERICAN MACHINIST.

Thoroughly competent draftsman and designer desires responsible position with progressive concern in Greater New York; good mechanic. Box 991, AMERICAN MACHINIST.

Position in New York City wanted by mechanical-electrical engineer with fifteen years' experience; graduate Massachusetts Institute Technology; now employed. Box 4, AM. M.

Practical mechanical engineer, expert in designing, manufacturing and erecting, with energy, quick comprehension and accustomed to heavy responsibilities, wants position. Box 979, AMERICAN MACHINIST.

Expert designer and draftsman, shop trained, desirous of change January 1; 28 years' varied experience, engines, special and automatic machinery, machine tools, developing, experienced as superintendent and traveling salesman; over 7 years' in present position. Box 985, AMERICAN MACHINIST.

Draftsman, first class, desires position; has technical and practical training of 12 years; good executive; first class on tools and fixtures; familiar with all departments from patternshop to completed article; have five years of excellent experience in water meter manufacture and design; desires change. Box 995, AMERICAN MACHINIST.

Salesman, with thorough technical education and nine years' successful selling experience requiring engineering ability, wishes position with manufacturers of power transmission machinery and specialties; automobile accessories or any device, the sale of which requires a man of his caliber; highest references. Box 990, AMERICAN MACHINIST.

OHIO

Position of responsibility by engineer, experienced in designing, building, demonstrating, mill construction and equipment; fourteen years' practical experience; technical education. Box 981, AMERICAN MACHINIST.

Works manager or general superintendent invites correspondence from reliable concerns wishing to secure the services of a high class executive with a clean cut record, as an earning power. Box 2, AMERICAN MACHINIST.

PENNSYLVANIA

Works manager, at present engaged, desires change; 22 years' machine shop and foundry experience; successful executive, inventive, machine designer, duplicate manufacturer; can reduce costs and increase production. Write for full particulars, Box 980, AMER. MACH.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted—First-class man to set piece work price and time limits. Apply, giving experience and qualifications to Canadian General Electric Co., Peterboro, Ont.

Wanted—General foreman in a department manufacturing transformers in small and large sizes. Apply stating experience to Canadian General Electric Co., Peterboro, Ont.

CONNECTICUT

Wanted—Experienced mechanical draftsmen for detail work, in a concern manufacturing general rolling mill and hydraulic machinery; state age, experience and salary expected. Box 796, AMERICAN MACHINIST.

ILLINOIS

Punch and diemakers; men with experience on dies for watch parts and familiar with master plate system; eight-hour day and good wages; give experience and wages wanted. Box 967, AMERICAN MACHINIST.

MASSACHUSETTS

Wanted—First-class draftsmen. Apply Supervisor of Drafting Room, General Electric Co., Pittsfield, Mass.

Wanted—A general superintendent for a large manufacturing company in southern New England; salary $4000 to $5000 per year. Address "M. B. S.," AMERICAN MACHINIST.

Wanted—A practical pump man; one who can design, estimate power, efficiency and cost and superintend construction; would prefer a man who has had experience in steam engine and electrical work in connection therewith. Address, giving age, experience and references. "Pump," AMERICAN MACHINIST.

Manufacturing establishment making extensive additions wishes to procure services of competent draftsman to lay out and supervise the installation of shop equipment and to rearrange present equipment in a manner to procure best efficiency. Applicant must have had previous experience in this line; give full particulars, experience, age, compensation expected and when services will be available. Box 986, AMERICAN MACHINIST.

MICHIGAN

Wanted—Ten first-class toolmakers who have tools and understand jig and fixture work; customary wages. Box 936, AM. MA.

Wanted—Experienced gunbarrel and gun frame bluer. Please state experience, rate of wages expected, etc. Box 3, AMER. MACH.

Wanted—First-class tool-room foreman on jigs and fixtures; one who can get rapid and accurate production from a first-class equipped tool room. Box 935, AMERICAN MACHINIST.

MISSOURI

Wanted—Mechanical draftsman who has had experience designing woodworking machinery; state age, experience and give references. Apply Box 938, AMER. MACHINIST.

Wanted—An experienced man as foreman of machine shop employing about 100 men, who thoroughly understands the manufacture of woodworking machinery; must have occupied similar position; applicant will state age, experience and give references. Box 937, AMERICAN MACHINIST.

NEW JERSEY

Wanted—Four experienced draftsmen on gas engines; state experience, reference and salary expected. Box B, AMER. MACHINIST.

Wanted—Experienced millwright and steam engineer to take charge of 300-horsepower plant; factory construction, repairs; largely overtime; good salary. Address "Steady," AMERICAN MACHINIST.

NEW YORK

Designers wanted, experienced on fine gage, jig and fixture work; give detail of experience, age and rate expected. Box 941, AM. M.

Wanted—Experienced toolmakers on fixtures and gages; state experience, age and rate per hour expected. Remington Arms Co., Ilion, N. Y.

Wanted—A thoroughly competent web printing press draftsman; man of experience and ability can have permanent position at high salary; communications confidential. "W. W. C.," AMERICAN MACHINIST.

Wanted—For stove plant near Chicago, an assistant superintendent, college graduate preferred; practical experience essential, either foundry machine shop or sheet steel stamping shop. Address H. P. G. N., AMER. MACH.

Wanted—First-class floor inspectors for drill press, milling and bench work; top price paid to steady competent men; no others need apply; nine-hour shop. Apply E. R. Thomas Motor Company, Buffalo, N. Y.

Wanted—Clerk for drafting room in engineering works in small town western New York; to enter and index drawings, superintend filing, copy lists of quantities, etc. Give fullest particulars and state salary, addressing Box 939, AMERICAN MACHINIST.

Wanted—Foreman to run rough grinding, polishing and buffing department in a large automobile factory; must be a man who has held similar position and one who can produce results. Address H. A. G., Care Frank Seaman, Inc., 30 West 33rd St., New York City.

Wanted—Man for time study and planning work in connection with the installing of a profit sharing system in a large manufacturing business; opportunity limited by efficiency only; state experience and salary expected during period of becoming familiar with business and demonstrating ability. Box 944, AMERICAN MACHINIST.

Wanted—By machine tool works in prosperous city of 200,000 experienced foreman, now employed, preferably not over 30 years of age, for machine department having 40 men; must be up-to-date on production by interchangeable method; good opportunity for right man; give age, nationality, experience, salary expected and reference. Box 969, AMERICAN MACHINIST.

OHIO

Wanted—First-class machinists; no labor troubles. The Heisler Co., St. Marys, O.

Wanted—First-class sheet-metal man, capable of managing sheet-metal department in a large automobile concern; must be thoroughly experienced in punch and die work; state age, experience and salary. Box 945, AMERICAN MACHINIST.

Machinists—We are increasing our output and invite application from machinists with experience on planers, turret lathes, boring mills, milling machines, screw machines, etc.; state fully, experience and wages. Foos Gas Engine Co., Springfield, Ohio.

Wanted—Factory superintendent who thoroughly understands punches and dies and can handle men to get out work right and at low cost in hardware manufacturing plant employing about 100 men; must understand design and finish of hardware. Box 989, AM. M.

Wanted—First-class machinists, toolmakers, die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood patternmakers, brass molders, polishers, buffers, finishers, spinners, millwrights, hammermen and blacksmiths who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Bldg., Cleveland, O.

PENNSYLVANIA

Wanted—Toolmakers, machinists, assemblers and all kinds of first-class mechanics on automobile work. Box 934, AMER. MACHINIST.

Wanted—Particular and ingenious machinist for assistant foreman; shop manufacturing mechanics' tools; this is an opportunity for the right man. State experience and wages. Box 976, AMERICAN MACHINIST.

Wanted—Foreman for small shop manufacturing medium weight specialties; must be familiar with modern methods and systematic; state age, experience and whether married; a good salary will be paid to the right man. Box 988, AMERICAN MACHINIST.

WISCONSIN

Wanted — Foreman for strictly modern foundry; man who has good executive ability and one who is a thorough, orderly and systematic man; foundry located about 100 miles from Chicago in city of 30,000 people; must be young and thoroughly experienced; state past experience, age and salary expected. Address Box 993, AMER. MACHINIST.

Press Tools for Computing-machine Parts

Accurate Punches and Dies Perform Blanking, Shaving, Piercing and Other Operations in Producing a Variety of Interchangeable Parts

BY F. A. STANLEY

The Connecticut Computing Machine Company, New Haven, Conn., uses in the manufacture of different parts for their adding machines a large number of subpress tools of the guidepost type, having either two or four pins for preserving the true alinement of punch and die. The halftones and line engravings illustrate some of these tools as well as the pieces which they produce.

Shaving Tools

Fig. 1 illustrates a shaving punch and die for finishing the piece shown in the background and at the side of the die. This blank is approximately 8 inches long, has a series of teeth along one edge, a group of notches opposite, a series of steps on the sloping end and other projections, all of which must be finished accurately. In the blanking operation two or three thousandths are left all the way around for shaving in the tools shown in Fig. 1, and a hole is pierced near each end as a means of locating the blank in the shaving die. The shedder or ejector for the die will be seen projecting above the face of the die at *A*, and near each end is a locating pin, the two pins taking the place of the nest usually employed on shaving dies.

Each of the locating pins, shown at *B B*, is enlarged near the lower end and a series of rack teeth is formed thereon which mesh with a pinion formed on the inner end of shaft *C* by means of which the pin can be controlled from the front of the die. As the punch descends, forcing the blank into the die, the locating pins descend, rotating shafts *C C* toward the left and allowing catch *D* to swing past the end of rocker arm *E*, so that the pins will be prevented from rising again upon the upstroke of the punch. When ejector *A* rises above the face of the die the blank is easily removed, as the locating pins are held below the surface. The operator then presses the end of catch *D* and the pins spring up to their former position, ready for the reception of the next blank. This arrangement of locating pins is used on a number of shaving dies at this factory.

This method of shaving the blank in the die is advantageous as regards the production of square surfaces with smooth finish. The die cuts, of course, from the bur side of the blank. The ejector, as will be noted, not only removes the work from the die, but serves to hold the blank flat and rigid while it is being forced into the die.

As shown, the die is made in sections to avoid distortion in hardening and facilitate renewal of any injured part. The die sections are not set into the cast-iron base but are secured firmly in place by fillister-head screws and dowel pins.

Combined Piercing, Blanking and Shaving Tools

The tools shown to the left in Fig. 2 are of interest in that they combine the operation of shaving with the piercing and blanking of the work. A piece of the scrap will be seen in front of the upper tool, and several blanks are shown at the bottom of the engraving. The idea will be understood more clearly, however, from Fig. 3, which shows the scrap and the blanks.

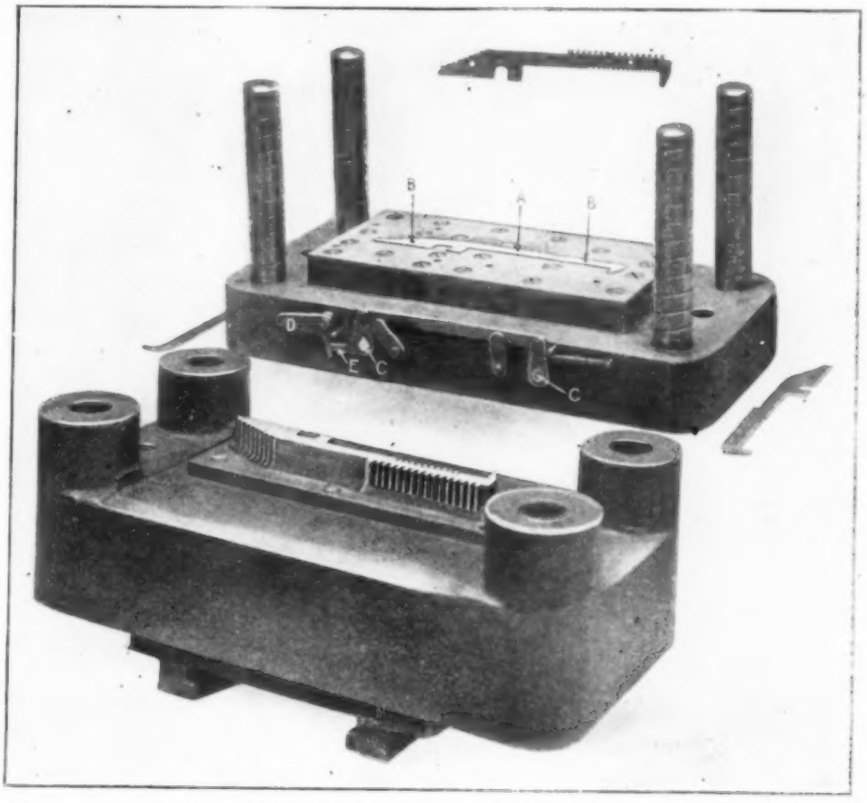


FIG. 1. SHAVING DIE WITH HANDY BLANK-LOCATING PINS

This blank, like a number of others used in the computing machine requires shaving at certain points only instead of around the whole periphery. In this particular case the ends *F* and *G* are most important and shaving is done only along these surfaces. An inspection of Fig. 2 in conjunction with Fig. 3 will reveal the sequence of operation. First, as the upper tools descend the curved slot *H* and their regular opening *I* are punched out, the hole for the pivot pierced at *J* and an additional locating hole at *K* also pierced. In punching openings *H* and *I* two or three thousandths is left along those surfaces which constitute the important ends of the blank. The next stroke cuts out the blank, leaving the opening as shown at *L*, where, as will be seen, the pointed nose of the piece and the irregular notch at the bottom have been shaved, the material removed by the shaving tools being very clearly shown in each of the blank openings.

In piercing the slot *H* and hole *I* the surfaces later to be shaved are really formed on the scrap, and the body of the metal supports these points sufficiently so that the edge of the metal instead of being rounded off to a considerable degree, making succeeding shaving operations difficult, is left practically square and the shaving tools have an opportunity for producing a clean, smooth surface, without rounded or depressed corners.

Another Set of Blanking and Shaving Tools

A similar method is illustrated in con-

nection with the dies shown at the right in Fig. 2. These tools produce a small diamond-shaped piece, having at one end a narrow lug which must be held closely to size. Five of these pieces will be seen lying at the front of the punch, while to the left are two pieces of scrap in the form of a letter *H*, which are removed in roughing out the outline of the ears or lugs which are to be shaved at the second stroke of the press. The openings in the die are so clearly illustrated that little explanation is necessary to make the operation of these tools clear. It may be pointed out that two blanks are finished simultaneously, these being produced with the important ends pointing toward each other. The H-shaped opening in the die and the scrap piece as punched through leave a projection for the ear on either side two to three thousandths inch wider than required, and the next advance of the stock brings the projections over the corresponding openings in the blanking die, so that the blanking stroke also accomplishes the shaving of these points.

A Nurling Die

The tools to the left in Fig. 4 produce a cam-shaped piece known as a locking segment, which has at the end of the arm a curved surface which is nurled to form a series of teeth. This nurling is done in the die simultaneously with the blanking of the piece itself. Upon examining the scrap stock shown behind the die, it will be noticed that as the strip enters the tools a curved slot (seen near the right-hand end) is punched near one edge and three holes pierced at the same time. The inner wall of the curved opening forms the outer end of the locking segment, and as the strip passes over the blanking die and the piece is blanked out, the curved end *M* is forced down past an inserted die block at *M'*, having teeth cut on its contact face. Thus the end of the piece is held accurately to shape and nurled at the same time.

A Shaving Die with a Swinging Nest

The interesting feature of the press tools shown to the right in Fig. 4, is the swinging arm which is provided with a nest in which the blank may be placed, after which the arm is moved around over the die, carrying the work into position to be shaved. As the punch descends the pilot *N* enters the guide bushing at *O*, thus holding the nest fast during the shav-

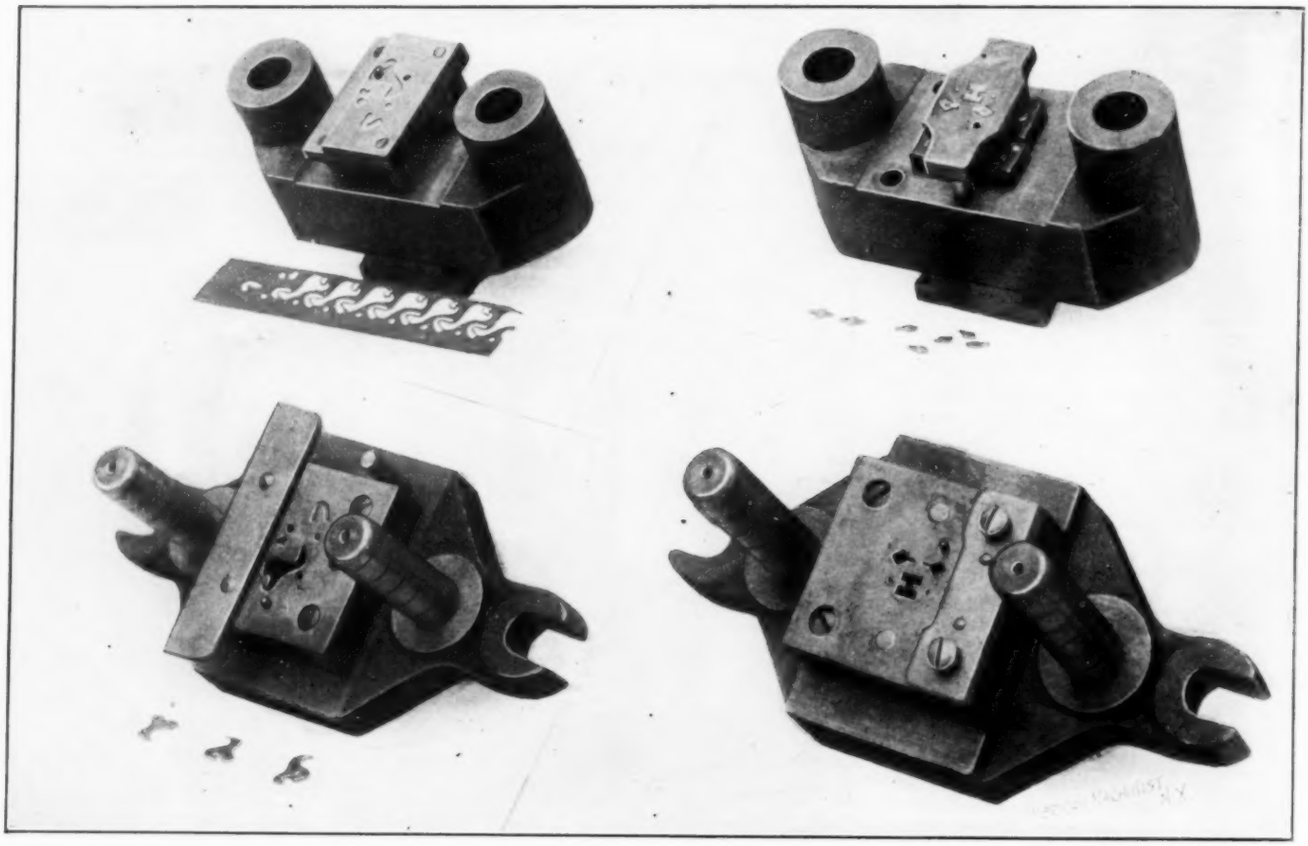


FIG. 2. TWO SETS OF BLANKING AND SHAVING TOOLS

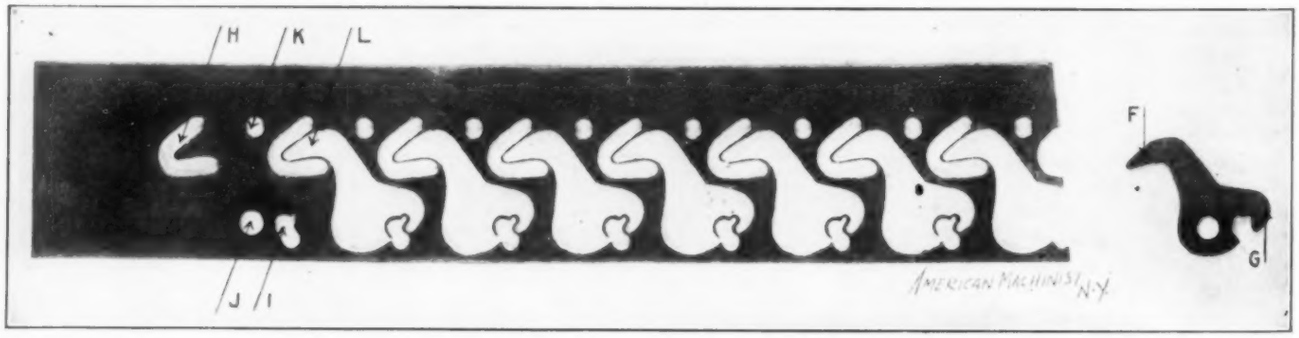


FIG. 3. THE WORK AND THE SCRAP—ILLUSTRATING METHOD OF SHAVING AND BLANKING

ing operation. Upon the return stroke of the press the shedder is held down by mechanism under the die leaving the work in the die so that the nest can be swung open as illustrated and the shavings or scrap brushed off. The shedder is then released and the die is ready for the next blank.

Perforating and Blanking Die

In the tools shown in Fig. 5 a series of ten small holes are punched near one edge of the piece, two larger holes near the end, and the work is then blanked at the second stroke. The small punches in this case are not fitted tightly in place, but have one or two thousandths freedom. They are held central, however, and guided right down to the work by the bushings shown in the stripper plate. With this arrangement there is no chance for the punches to deflect and, therefore, little liability of their breaking in service.

Sectional Die for Brass Plates

The brass plate shown in the foreground in Fig. 6 is known as a ribbon shield and has a series of rectangular openings formed along the center, with larger openings at either end, while the back edge is curled around so that the piece may later be hinged in place. After this edge has been curled the piece comes to the die, where one end is slipped over the pin P, a second pin in the end of lever Q being forced into the other end of the blank, thus holding it in correct position on the face of the die, while the openings are punched. The two main sections of this die are slotted along their inner edges and thin steel strips inserted to form the partitions between the openings. While these thin members are hardened and tempered, the two larger blocks are left soft. Still, although used for a long time, they show no wear and are still operating satisfactorily.

Another Subpress Scheme

The tools in Fig. 7 are illustrated as representing a method by which the work as blanked and pushed back into the stock for feeding along out of the die, may be inserted only halfway, thus enabling the pieces to be easily removed later from the scrap with no liability of their being bent, as may often happen in the case of an awkward or delicate piece which is forced back flush with the strip from which it is punched. The scheme consists in profiling around the punch opening in the shedder a channel R, whose depth is equal to half the thickness of the stock. Now as the die S descends and the stock is seized between the face of the die and the shedder around the punch, the shedder springs down and the piece is blanked in the usual fashion. Upon the up-stroke, however, the ejector in die S in pressing the blank back into the stock also causes the stock to spring down into the depression milled around the punch at R. As the stock springs down half its own thickness the blank therefore can enter its opening in the stock only half its thickness.

Forming Pins by the Extrusion Process

Figs. 8 and 9 illustrate two pieces upon which a series of small pins are formed by extruding the metal; that is, instead of drilling holes and riveting in pins, the metal is forced bodily up from the blank under hydraulic pressure into a series of die openings forming the pins accurately to size. As the process is identical in the case of both of these pieces, only one set of dies is illustrated; namely, the one for the "stop lock" shown in Fig. 9.

Referring to Fig. 10, the die proper is shown at D, attached to the fixed member of the hydraulic press, while the block E through which the punches operate, is attached to the press ram. The punches themselves, which are guided by this block and several of which will be seen at F, pass down through into a plate attached to a second ram inside of the one previously mentioned. In operation the

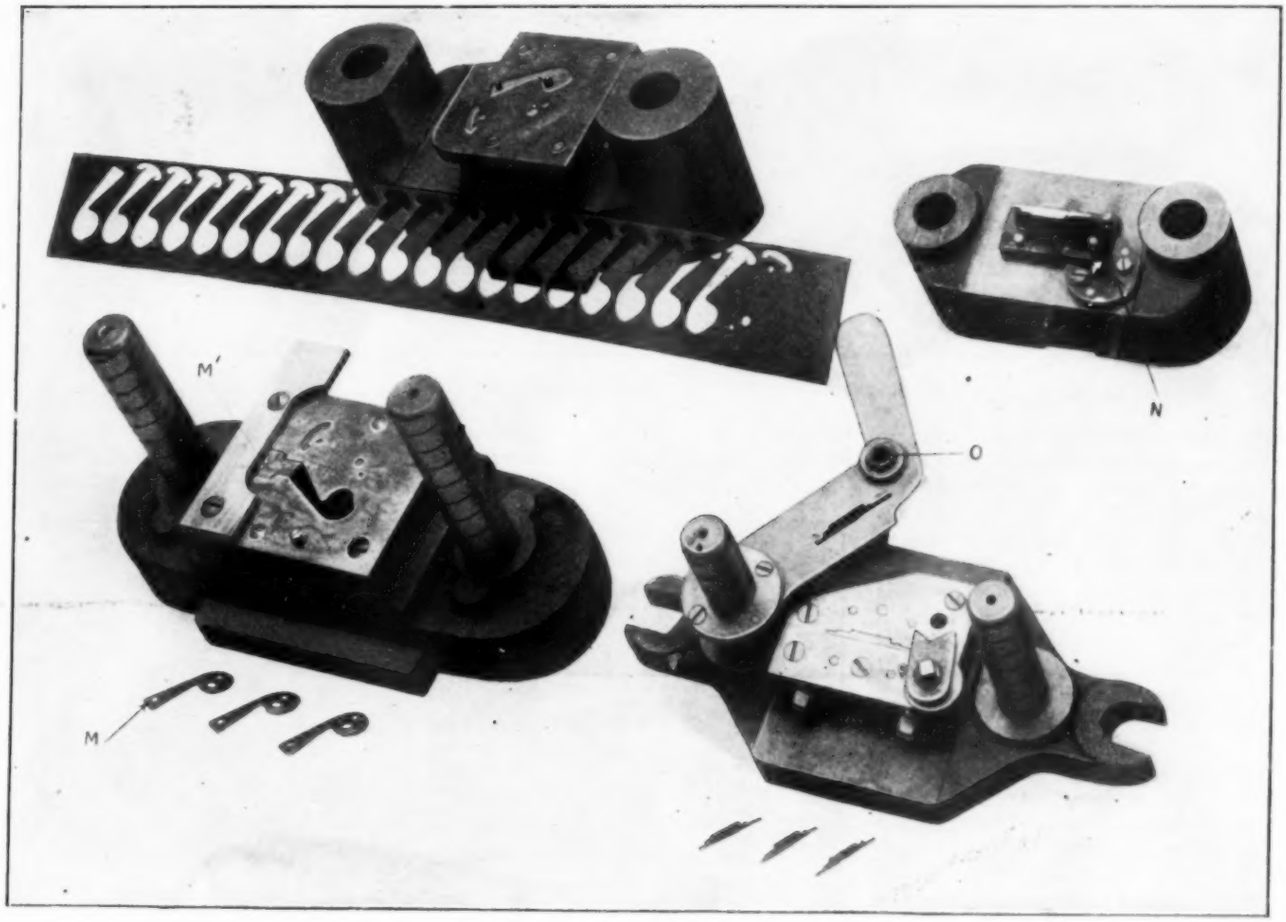


FIG. 4. OTHER TYPES OF SHAVING TOOLS

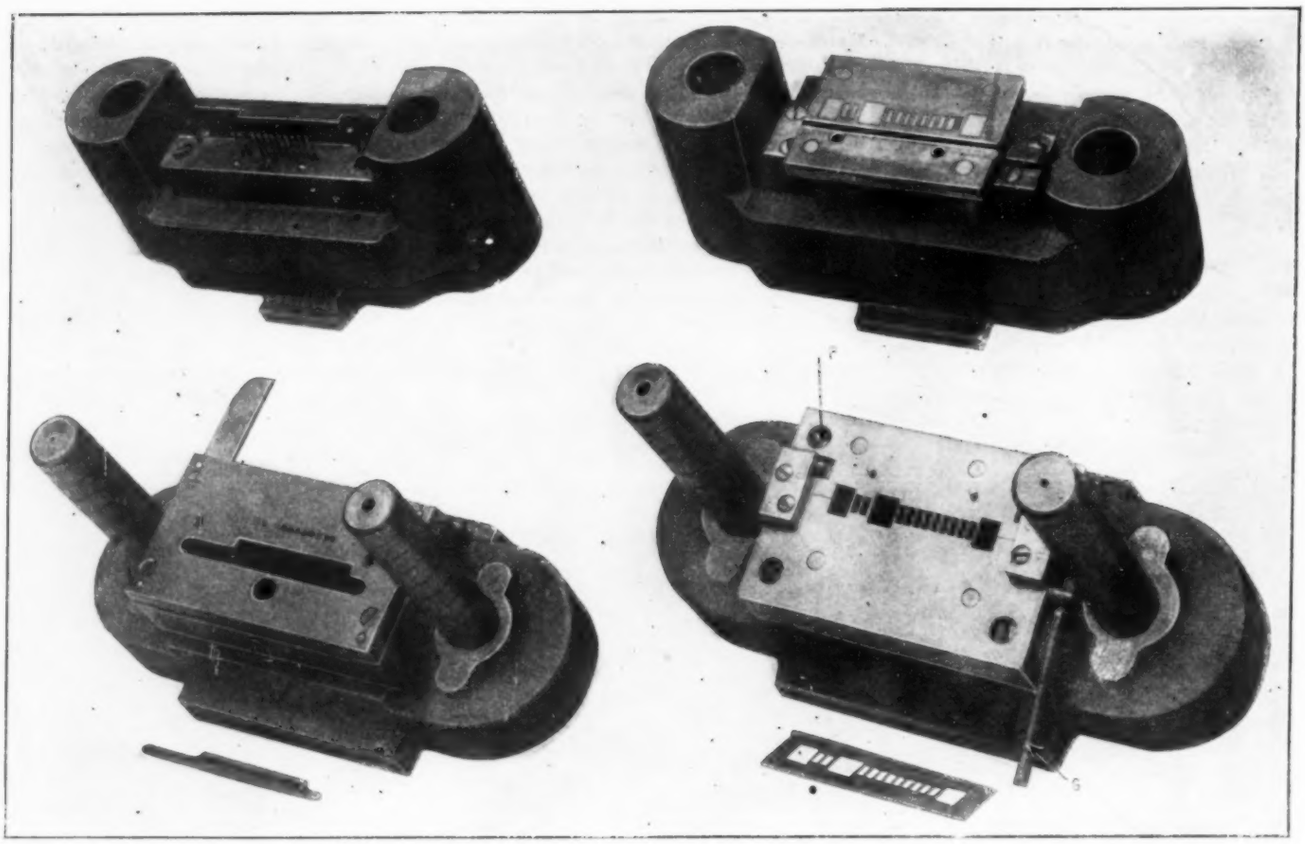


FIG. 5. BLANKING AND PIERCING TOOLS

FIG. 6. SECTIONAL TOOLS FOR FINISHING A BRASS PLATE

blank, Fig. 9, upon which the pins are to be formed, is placed on the face of *E*, the outer ram then rises rapidly and securely holds the blank between *D* and *E*. Heavy pressure is then applied to ram *G*, the punches *F* are forced up into the under side of the blank, and the metal is forced from the top into the die holes in *D*. The work is stripped by the action of pins *C* which are arranged in staggered form in plate *B*. It will be noticed that the pins formed by this process are somewhat higher than the thickness of the metal upon which they are produced. It is, therefore, obvious that the punches which displace the metal forming these pins must be considerably larger in diameter than the die openings. This process gives a pin which is accurate in size, perpendicular to the face of the work, correctly spaced for center distance, and the whole proposition is a much more durable one than if the pins were driven in place and riveted. The blanks on which the pins are raised are ground accurately to thickness and the tops of the pins are also held closely to the required hight.

A Bending Operation

The sketch Fig. 11 shows a piece before and after bending, and the press tools by which the bending operation is accomplished. The die upon which the piece is bent or formed is shown at *D*, the work being held in a nest and against the face of this die by a swinging jaw *F*, which is securely clamped by the cam lever at the front. In operation the wedge-shaped members *A* in descending act upon swinging yoke *B*, pressing this back and folding the blank down over the upper sloping surface of die *D*. The punch *C* continuing downward then forces the blank down

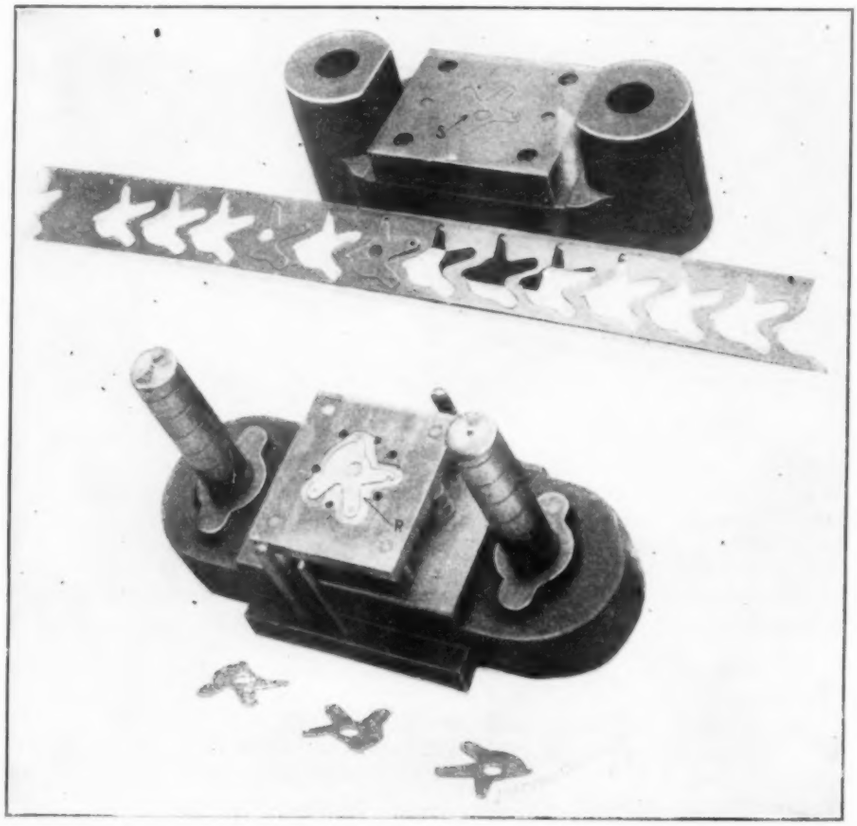


FIG. 7. CONVENIENT TYPE OF BLANKING DIE

over the die and forms it to the required shape. As the punch rises the yoke *B* is thrown back by means of a spring and the cam lever is operated beneath the jaw so that the work can be removed.

Combination Screw Machine and Punch Press Job

The small gear shown in Fig. 12 is of interest owing to the fact that it is formed partly on a screw machine and finished in a subpress die. This gear has a ball race which must be concentric with the pitch circle and care is taken throughout the manufacture of this part that it shall be accurately finished. In the first place a disk is blanked from sheet stock about 1/10 inch thick and approximately 1⅜ inches outside diameter, and is then taken to the screw machine, where it is held in a special chuck so arranged that the jaws close radially, obviating any possibility of end movement when gripping the work. Thus the facing tool when once set can be relied upon for bringing the piece to the required thickness without any trouble due to end movement of the chuck which

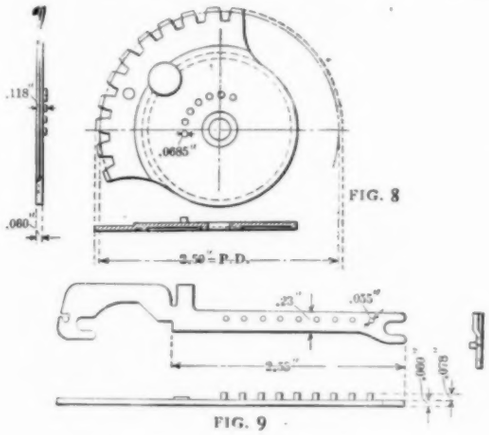
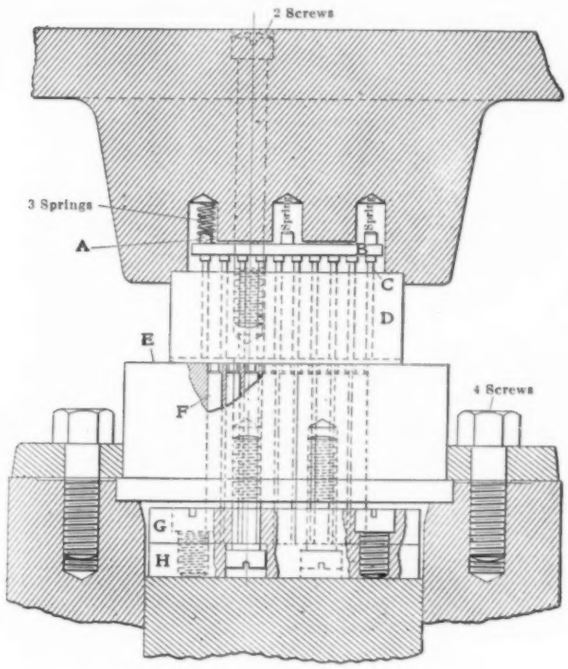


FIG. 8

FIG. 9



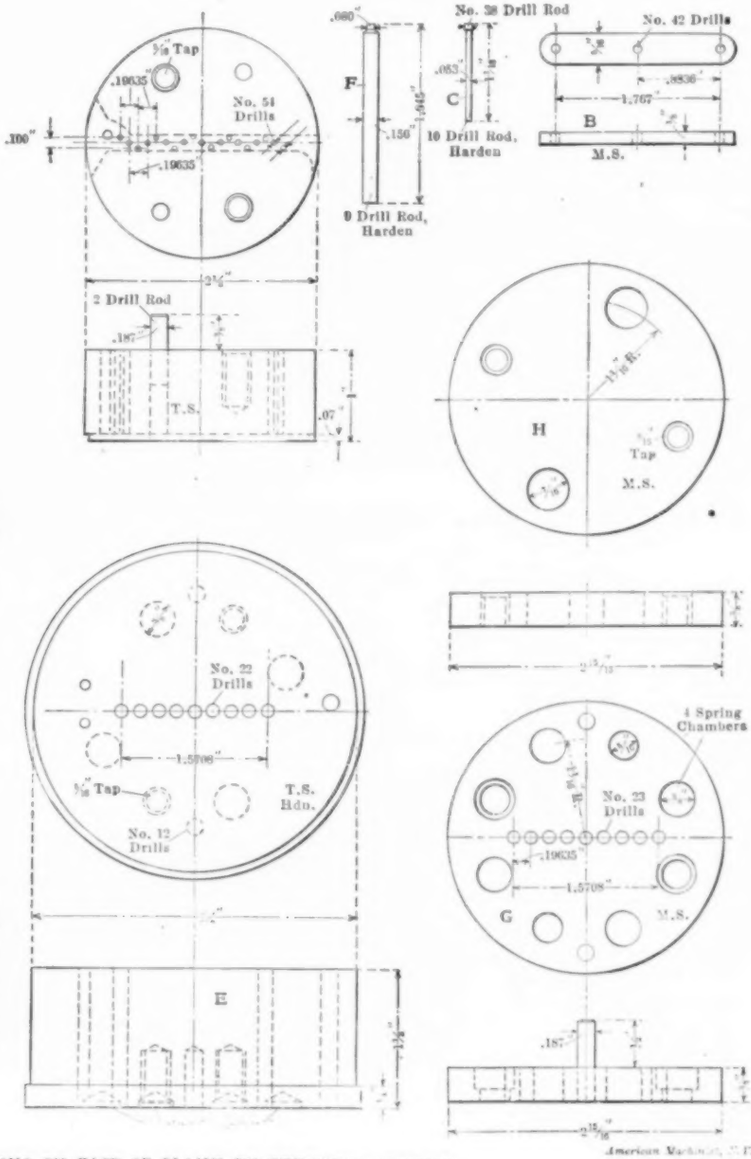
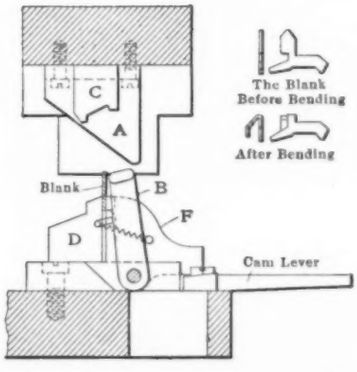
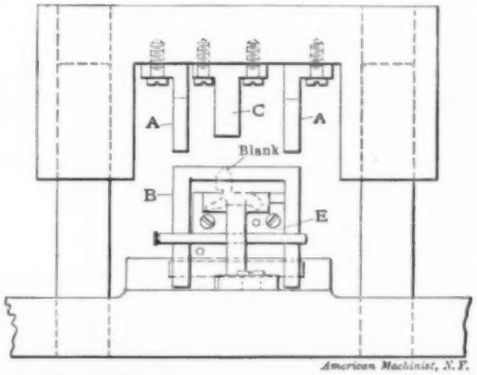


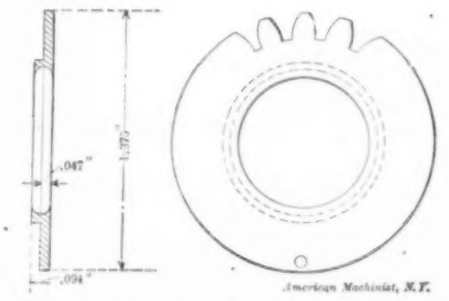
FIG. 10. TOOLS FOR FORMING PINS ON FACE OF BLANK BY EXTRUSION PROCESS





American Machinist, N.Y.

FIG. 11. BENDING DIES



American Machinist, N.Y.

FIG. 12. GEAR MADE IN PUNCH PRESS AND SCREW MACHINE

might otherwise occur when closing upon blanks varying even slightly in diameter. Here the stock is faced down well toward the bore and a special forming tool is then run in to machine the ball race. This tool is so arranged that its end can then be brought against a fixed stop, so that spring in the turret or toolholder in no way affects the diameter of the ball race or its concentricity with the periphery of the work. After this operation the blanks are taken to the subpress dies and there the teeth are formed and then shaved accurately to size.

To test the evil effects of lead upon copper, according to a paper read before the Institute of Marine Engineers, take a strip of the latter metal, and with a minute piece of lead upon it, heat over the fire to a good red heat, note the energetic action of the lead, and, after cooling, carefully examine the surface of the copper acted upon by the lead, remembering at the same time that the longer the copper is heated the deeper the lead will penetrate.

A Combination Machine Tool

By E. A. Dixie

Fig. 1 shows a combination lathe, shaper, milling machine and gear cutter which was built to order for its designer, Frank Bement, of Toms River, New Jersey. The lathe swings 10½ inches over the carriage and 31 inches between centers. The headstock is cast in one piece with the bed. The tailstock slides on two inverted V's on the top surface of the bed and is provided with two spindles one within the other providing both screw and lever feed for the tail spindle. The carriage slides on the front of the bed and may be moved beyond the headstock or tailstock as shown in Fig. 2.

Referring again to Fig. 1 *A* is the milling attachment which can be placed in position or removed in less than two minutes shown also in Figs. 3 and 5. *B* is the ball turning rest, shown in position on the lathe in Fig. 2. *C* is the taper attachment. *D* is a gear-cutting attachment, shown in position in Fig. 5. It is a regular commercial product and can be bought at any supply house. *E* is a pair of regular shaper centers shown in position in Fig. 3. *F* is the shaper attachment obtained from Boynton & Plummer, Worcester, Mass., which can be put in position in less than two minutes. It is bolted to the bracket *I* which is bolted to the back of the bed. The shaper attachment is shown in position in Fig. 4. *G* is a miller or shaper vise. *H* is the shaper feed shown in position at the extreme left in Fig. 4. At *J* is the rack and pinion traverse-motion box. Mr. Bement tells me that if he had another of these lathes built he would have the gear ratio lower as the carriage is apt to move by jerks when it is necessary to move it only short distances. The reverse for the carriage is situated here and this he would also alter, placing it at the headstock. *K* is the slide containing the half nuts. *L* is the lever feed for the tail spindle. *M* is the follower rest. *N* is the steady rest. *O* is the milling and shaping table.

The angle plate on the front of the carriage is raised and lowered by means of the screw *P*. When much work is to

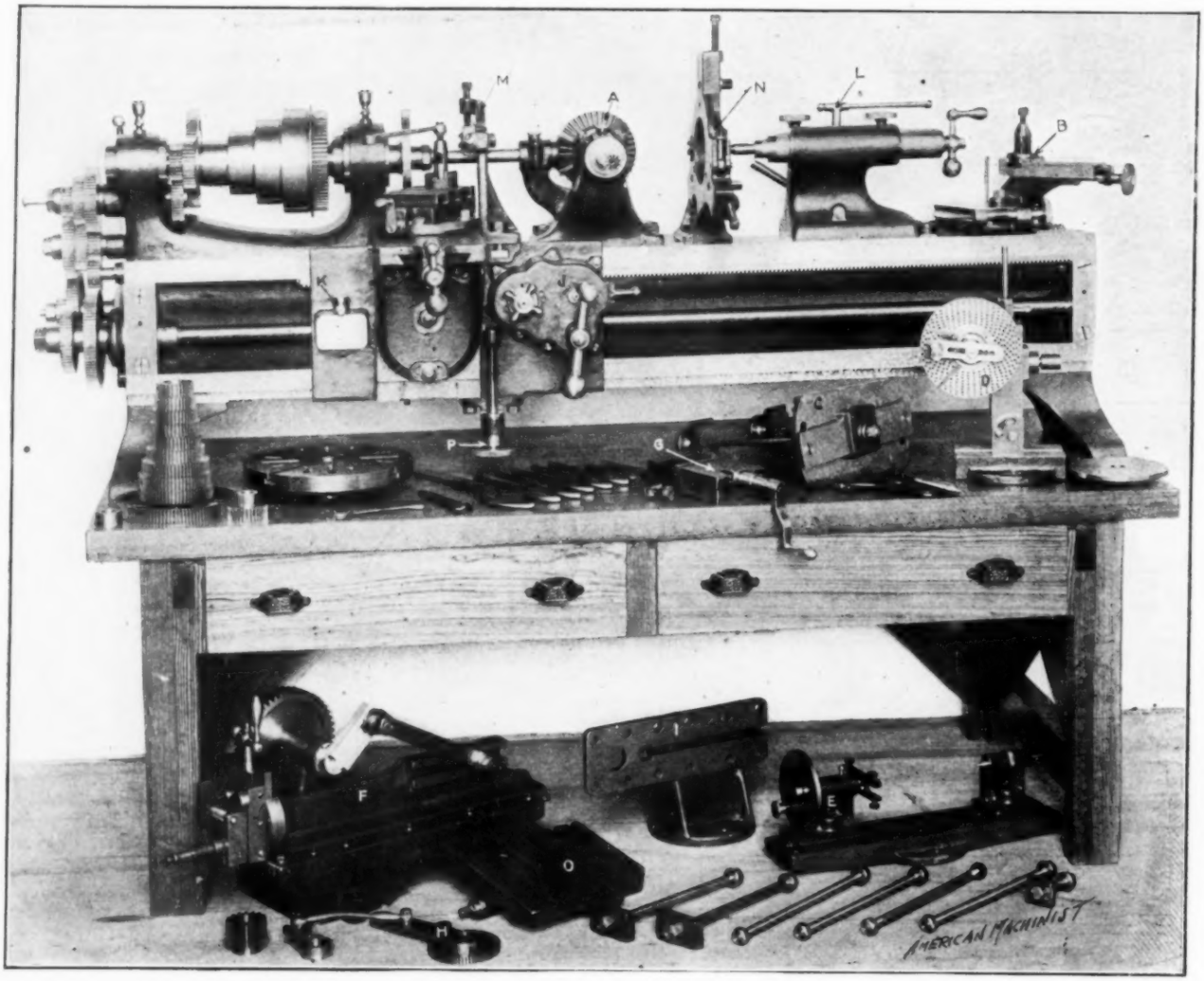


FIG. 1. GENERAL VIEW OF LATHE AND ALL ATTACHMENTS

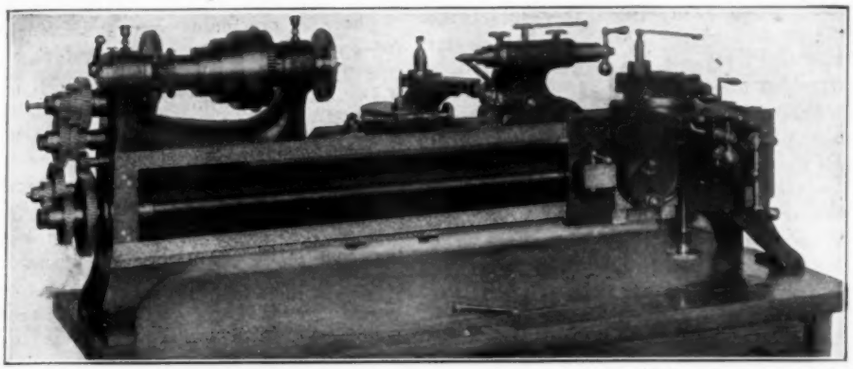


FIG. 2. CARRIAGE OUT OF THE WAY

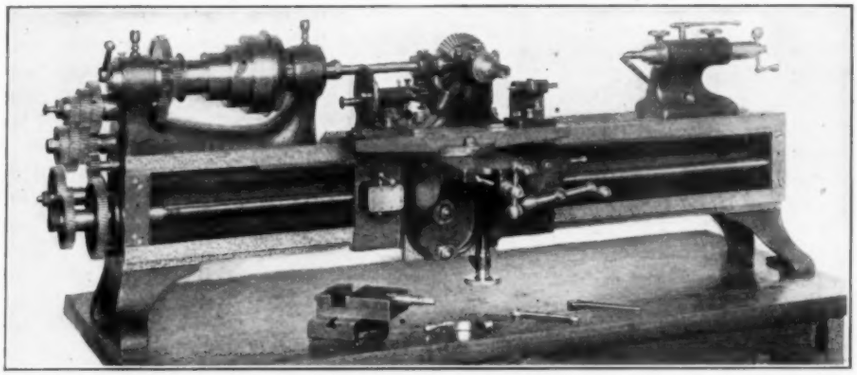


FIG. 3. INDEX CENTERS IN PLACE

be done requiring quick manipulation of this screw Mr. Bement has a wooden disk which he attaches to the nurled head of the screw.

The spindle has tapered bronze boxes to compensate for wear. The lathe has been run pretty constantly since 1902 and I was unable to detect any shake or end play in the spindle, although the bearings have never been adjusted during the seven and a half years of use. We put an 18-inch test bar in the live spindle and it ran out of true about 0.001 at the end. This was probably due to the hole in the spindle not being absolutely clean. Every screw in the lathe and attachments is standard including the lead screw which is cut with a U. S. standard thread. Mr. Bement has the patterns and drawings and told me he would lend them to anyone who wants to build one. I would, however, advise anyone to think well before starting, as this lathe cost him over $2500.

With reference to the subject of electric drive in the shop, the *Electrical Review* and *Western Electrician* calls attention to an important arsenal located at Terni, Italy, in which there are about 1400 machine tools in use and electric drive is used throughout the shops. The power is obtained from a water falls, where eight turbines generate about 1000 electrical horsepower. The average number of men employed is less than 1000, but this can be increased to 2000 if larger production is desired.

Why Are Pyrometers Discontinued?

By C. U. Scott

This is a question that I asked on page 1061, Part 1 of Volume 32, and I note with interest the replies of Mr. Coram and M. Dogecla, on pages 339 and 588, respectively, of Part 2.

I hardly think that Mr. Dogecla had refreshed his memory by reading over my article, as he has misconstrued or misquoted me. It is true I said that the pyrometer is being discontinued, but not on account of the one selected not being of the proper make or design. He also has an entirely different idea than I have of what Mr. Coram says in his article; however, I will leave that to Mr. Coram. The idea that I meant to convey, and in fact what I said, was that the pyrometer was being discontinued on account of not having the proper equipment for its use, not that there was some fault with the pyrometer. However, I am convinced that they receive their share of the criticism. It is true that Mr. Coram's method might be more expensive, but it is also true that it is accurate and this is just what we were in need of.

While it may be necessary to have the experience of the laboratory men to operate it, there is no reason why the hardener

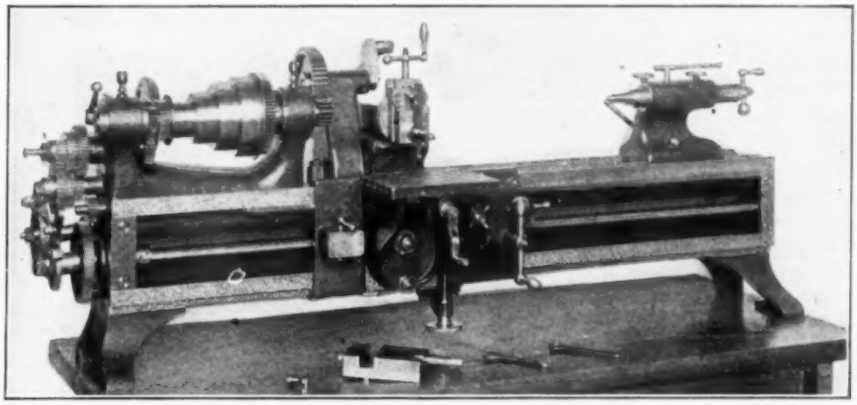


FIG. 4. THE SHAPER ATTACHMENT IN PLACE

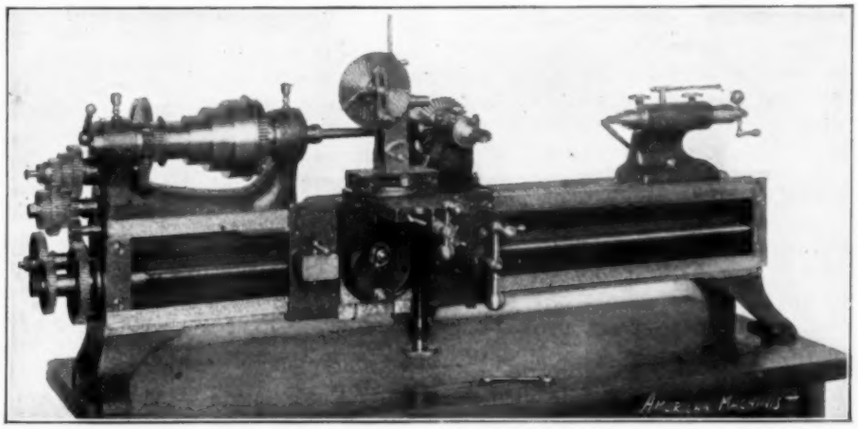


FIG. 5. THE GEAR-CUTTING ATTACHMENT IN PLACE

cannot become as proficient in the adjustment of the pyrometer as anyone. In fact, I think that he ought to be more proficient in their adjustment for the furnace than the laboratory man. Who knows better than the hardener when the heat is uniform? Who knows or has a better right to know when the pyrometer is registering the true heat? Then why should we not want as good a reading as the laboratory man? Is it the laboratory man who takes more heats in one day than the hardener? I think not. Then why should we not have as nicely adjusted and as correctly reading pyrometers as the laboratory man?

It would be well for the tool hardener to remember that it is not a matter of time but it is a matter of being sure that he is correct in calibrating. One of the greatest errors that the hardener makes is the one of not taking time to be sure that he is correct, not alone in the calibrating, but in doing his work in general. It is necessary for us to do our work so that when there is a piece of work sent to our department for annealing, it will be annealed when sent out. If, on the other hand, a piece is sent to the hardening department to be heat treated, let us be so correct in our work that the results will be uniform. This is what our employer desires and will be the cause of the hardening department becoming one of the most important departments in the manufacturing of machinery where the pyhsical qualities of the steel are to be considered.

The experimenting in calibrating, that comes under the observation of tool hardeners is done by the professors and men high in science. To me it presents itself in this light, namely, no one should be better posted in the correct heat either by a pyrometer or by sheer judgment than the man who is taking from four to five thousand heats per month. No one should have a better knowledge when metals are congealing. No one should know better when two pieces are at the same heat, for he has the trained eye. He is able to look in the fire without getting burned. He can see more in the fire than the man who is not using it as he is.

We have often heard the remark that there are scarcely ever two tools just alike. This is caused by the tool hardener, who thinks that "just about right" is good enough. If we are to reap the full benefits of all that science has placed before us, we must be precise in calibrating, our work, and take nothing short of what we know to be correct. I know that we are rushed with work; we think that we cannot give such trifling things so much time, and our employer, we fear, cannot afford to spend the money for what is needed for the successful operation of one branch of his business. The thing for us to do is to prove to him that it will pay him to have what is needed, even if it is a platinum plate. One idea that I had in mind when I presented this subject to the readers of the AMERICAN MACHINIST was that I hoped for the adoption of a standard for calibrating of the pyrometer.

Let us look at this subject in the true light of ability and what do we see? We see the scientific man, the professor, at the fire taking a heat on a piece of steel and gaging this heat with the pyrometer. Where will we find the fire end? If it is a tool they can hardly drill a hole for it, and probably would find the fire end in one of the vents of the furnace. If so, is this the correct place for it? Surely not. Then who would be the better able to judge correctly, the man who has spent the greater part of his life in taking heats, or the man who has taken possibly a few hundred? I have no objection to the scientist or to any other branch of the higher professions, but I do seriously object to the idea of an instrument that has to be perfect for the laboratory and just somewhere near correct for the tool hardener.

It has never been possible for the tool hardener to know that he was correct until he had the help of science. Are we going to allow ourselves to be contented with something very near correct from the fact that we are not going to be as careful and painstaking in using it as the man who has made it possible for the office man (who has never taken a heat on a piece of steel) to direct us in an intelligent manner? Some may smile at the thought of being directed by one who knows so little of the mysteries of hardening steel as the average office man, but let me say that it is possible for him to become very proficient at it. Science has caused the mysteries to vanish.

It is no uncommon thing for me to receive orders as to the treatment of steel, and I know from the instructions that the treatment is well selected. I do not anticipate the tool hardener losing any of his prestige by being directed in his work, however; quite to the contrary, he will become of much more importance from the fact that he can be relied upon to produce accurate results. The pyrometer or the calibrating will never be the whole thing. They will never be able to take the place of the man at the fire. These are helps, as is the micrometer to the machinist. We surely would not expect the machinist to measure as accurately with the scale as we would with the aid of the micrometers, but if his micrometers were not as correct as the man's who was inspecting his work, we would expect him to get in serious trouble. His work would not be what was called for, and in many instances it would be worthless. Just so with the tool hardener, when directed to do a piece of work by given heats and baths for cooling, if his instrument was not correct, his results would not be correct. And again, if the pyrometer has been discontinued he cannot successfully heat-treat steel.

There is one point very noticeable to me in Mr. Coram's article and that is that he calls attention to the fact that there should be no flame striking the work in using the pyrometer. This is a broad statement, and while he does not put it as strong as I have quoted him, I am sure that he agrees that there is but one accurate way to take positive heats and that is by the use of baths such as lead, salt, etc. I much prefer the lead bath to all others, and while I hesitate to make the statement, I am convinced that the lead bath will become the prominent way of heating where accuracy is desired. While it has been made a scapegoat for many years, the time has now come when its true worth can be seen.

I am using the crucible process in the calibrating of my pyrometers with good results. First, I have a crucible 2 inches in diameter by 4 inches deep. I heat this to temper it and then allow it to cool. I then thoroughly clean it by scraping the inside. Then I place 3 ounces of sodium carbonate (melting at 814 degrees Centigrade), or sufficient to allow the fire end to be immersed at least 1¼ inches and allowing it to be ½ inch from the bottom of the crucible (doing this work in a vertical furnace). I then suspend the fire end so that it does not touch the sides of the crucible, having arranged the fire so as to not allow the flame to pass out the top: I then commence to take my heat.

Sodium carbonate as it melts will gather in a ball, and as the last part of this ball is melted, I take the reading to see if it is anywhere near correct. I then shut off my heat and allow the liquid to solidify, noting the readings at intervals of 10 seconds. I have no trouble in finding whether my pyrometer is correct or not, as the tendency to hold heat is much greater as the liquid solidifies. After I have repeated this, I then determine the correction from observing the solidification, taking the readings when it is solidified. In this manner I get readings in three different ways, and note their correctness. However, I rely on the one taken as the liquid solidifies.

At any time that there is very much of a variation in the three heats, I repeat the entire operation in order to know where I have erred. For the higher heats I use copper (melting at 1084 degrees Centigrade), and again I have used nickel, but not in the crucible, as the highest heat that I am able to get in the open fire (gas) will only be sufficient to bring the nickel to a mushy state. For the lower heats I use lead (melting at 327 degrees Centigrade), and zinc (melting at 450 degrees Centigrade). All of the above must be chemically pure.

Let us have a standard for this work and let no detailed part of the method be omitted, giving the exact amount of material to be used, the exact time for taking the reading, how the fire end shall be applied, etc.

Transmission of Writing by Machinery

Steel Arms and Fingers Which Guide a Pen to Reproduce Written Messages in Obedience to the Will of a Distant Writer, in His Own Handwriting

EDITORIAL CORRESPONDENCE

Those of us who remember our Sunday-school days will have no difficulty in recalling how the cold shivers used to run up and down our spines when we were told that ancient story of the handwriting on the wall.

Reproduction of handwriting at a distance has always been one of the most startling exhibits of magicians. Any ancient book on the subject of the magic art and even books on chemistry give various formulas and directions for the making of what was known as "sympathic ink," or ink which would be visible only under certain conditions, these conditions being produced at the will of the operator and unknown to the person to be deceived. In these days ideas are gotten up for commercial use rather than for the purpose of mystification, and today after more than 20 years of development, there is a commercially practical device upon the market, which will reproduce the act of the handwriting on the wall. The fingers of this hand are made of steel, very light and slim in construction and very quick in movement. They are incased in a metallic box with a glass front and it is positively uncanny to see these mechanical fingers trace over a sheet of paper and spell out words and sentences with no visible director of their motion. All of this is done by the telautograph as manufactured by the Gray National Telautograph Company of New York City. The object of this instrument is to reproduce at a distance a message written by a sender upon a sheet of paper on a desk.

This instrument, as will be seen, has some advantages over the telephone. While, of course, a person cannot write as fast as he can talk, he is unable with

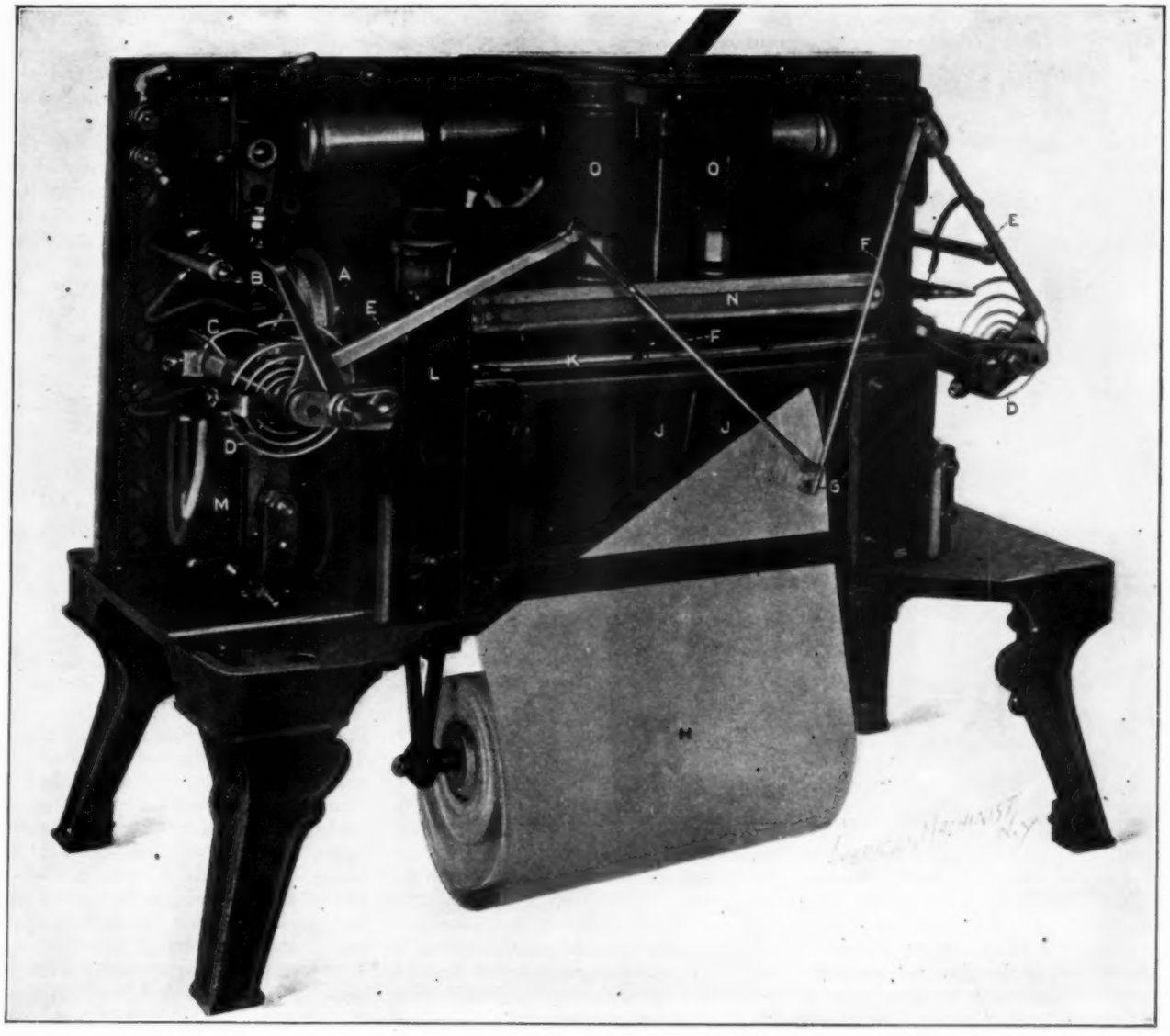


FIG. 1. THE RECEIVING INSTRUMENT

A, position of movable coil. *B*, pole piece of main magnet. *C*, chain connecting coil to lever axis. *D*, springs. *E*, levers. *F*, links. *G*, recording pen. *H*, paper from roll. *J*, pen-lifting magnet coils. *K*, pen-lifting bar. *L*, ink bottle. *M*, antifriction vibrator. *N*, paper-shifting clamp. *O*, magnet coils for *N*.

the telephone to do his talking and transmit his message unless the listener is at the other end of the telephone at the time the message is sent. Even supposing the listener to be present, there is always some doubt in the mind of the latter as to just what the message was, especially if it involved complicated details or figures and he often wishes he had a written record in front of him to consult for the purpose of clearing up his doubts.

No Waiting for a Hearing

By means of the telautograph the sender does not have to wait for the receiver of the message to be present at the other end of the line, for when the latter returns to the instrument, there he finds the message written out in long hand during his absence and he is at liberty to read it as often as he desires with no possibility of having misunderstood what was said. Furthermore, as the handwriting transmitted is almost an exact reproduction of the handwriting of the sender, the receiver can at once recognize whether or not the message is genuine, this recognition being even more certain than the recognition of a well known voice over the telephone. With the transmission of the actual handwriting the worn-out story of the old lady who suspected that her telegraphic message had been read by the operator does not seem so ridiculous, for she would have before her what would appear to be a note written by the very hand with whose chirography she was perfectly familiar.

No Disputes

At first the principal uses for such a device as the telautograph were in hotels, especially between a restaurant and a kitchen. When a breakfaster orders his eggs fried on both sides, the waiter transmits his order to the kitchen in writing by means of the telautograph and if the cook sends back the eggs "sunny side up," there can be no dispute between the waiter and chef because each has a written record of the actual message transmitted. From the restaurant-kitchen installation the use of the telautograph has been extended enormously and the modern hotels of today are equipped with extensive systems of both transmitters and receivers. In some of the larger hotels in New York City these instruments are connected by means of a central office having several operators, these operators working instruments very similar to telephone central switchboards. By means of these systems messages can be sent from any one part of a hotel to another, announcing visitors to guests, asking for clean towels, ordering cocktails or complaining that the steam heat is out of business. If later any question should arise as to whether or not such a message was received, it is only necessary to inspect the written records of the telautograph, whose word cannot be doubted, especially when the exact handwriting of the sender is before him to stare him in the face.

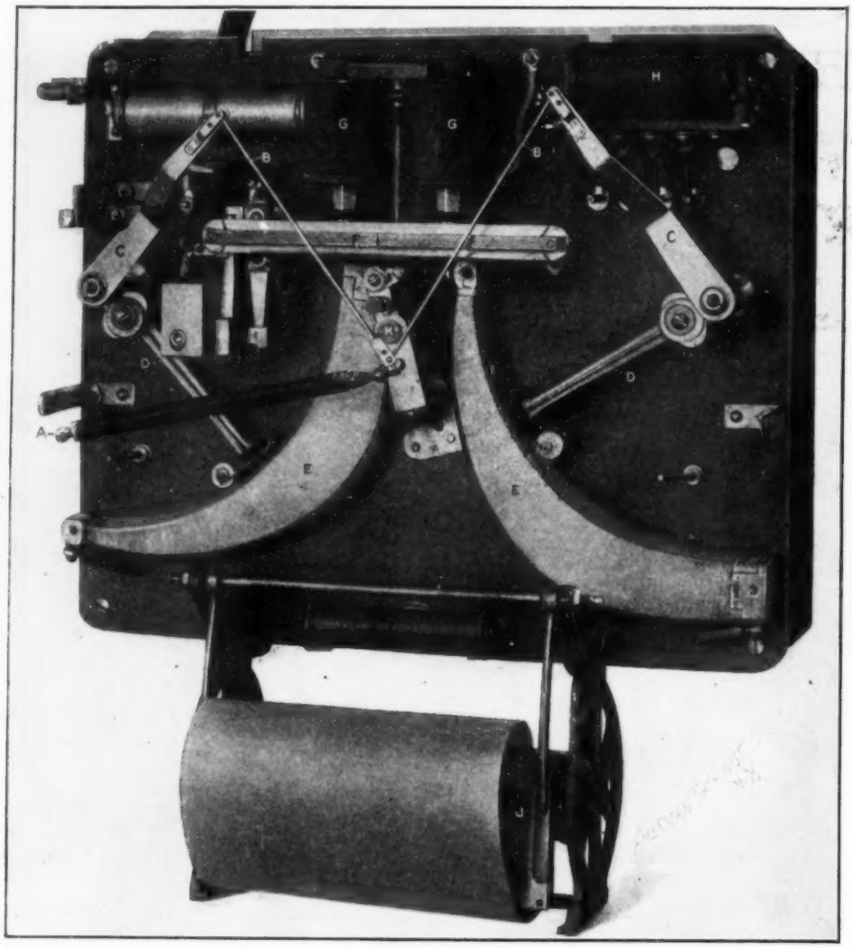


FIG. 2. THE TRANSMITTER

A, writing pencil. *B*, links. *C*, levers. *D*, contactor arms. *E*, rheostat coils. *F*, paper-shifting clamp. *G*, magnet coils for *F*. *H*, relay-controlling connections. *J*, writing platen, turned down. *K*, platen contact button for pen lifting.

From these uses the telautograph has grown to include commercial businesses outside of hotels and restaurants. It is now being used in machine shops, boiler shops, rolling mills and other places where it is especially necessary that messages shall be absolutely understood and where owing to the many external noises always existing in such manufacturing establishments, it would be more than difficult to understand what was being said over telephones. Even now a special form of watertight instrument is being used for the United States Army in the Coast Defense Department where the men located at the top of the range-finding tower are able to transmit to the gunners the range of the enemy. The exact words and figures are always before the gun operator in the writing of the range finders themselves. This machine is attached to the gun carriages by means of spring suspensions and they are so constructed that even the heavy shock and recoil of the gun will not injure the instrument nor make its writing unintelligible. Now that the tall fire-control towers have been added to our men-of-war for more accurately determining the range of the enemy's ships it is proposed to use the telautograph in the navy for transmitting messages from the top of the tower to the gunners in the turrets.

A certain coal company in New York City has private telautograph lines leading from its main office in the extreme lower part of town to One Hundred and Thirty-fifth street on both the North and East rivers. Another line also extends under the river to Communipaw, New Jersey. These lines are used for sending orders, numbers, etc., which were subject to frequent misunderstandings when formerly sent by telephone.

It is thus seen that there is a very wide field for such an instrument and it is said that the demand is far exceeding the supply that can be turned out with the present available factory facilities. Some persons will undoubtedly desire to know in a general way how the telautograph operates.

The Principle of Operation

It is a rather curious thing that after long years of experimentation and the production of more or less imperfect instruments involving the most intricate

complications and difficulty of construction and operation, the final outcome of the machine operates upon the very simplest of principles, is not difficult to manufacture and requires no skill nor special attention on the part of either the transmitter or the receiver of messages. Electricity is, of course, the means of transmitting the written messages, but like most electrical devices, electricity itself is simply the means of transmission, and the actual working of the machine is mechanical and not at all difficult to understand.

Receiving the Message

Message receiving is accomplished by an instrument known as the receiver. This instrument is provided with a pen held by two links of light steel normally standing at about right angles to each other. The other ends of these links connect to the outer ends of two swinging levers, the inner ends of the levers being swung about pivot fulcrums by means of delicate chains from movable electric coils traveling in a magnetic field. By the combination of the component motions of these two levers and links the writing pen may be caused to occupy any definite position within a certain definite area of the paper upon which the writing is to be produced. The levers holding the pen are normally pulled by spiral springs so that the pen is over at the left side of the writing pad and enters an opening in the side of a special ink bottle. The pull of the electric coils in the magnetic field reacts against the resisting springs so as to turn the levers and pull the pen away from the ink bottle and out upon the writing pad and by the variation of two independent electric currents in the two movable coils controlling the two levers and links, the pen may be caused to move back and forth and up and down so as to trace any sort of a line or curve over the paper.

From this it will be seen that the operation of the device is by means of electric currents of variable strength and the object of the transmitting machine is solely for the purpose of producing these variable electric currents. The strengths of the currents depend upon the position of the writing pencil of the transmitting instrument in the hands of the writer, and these currents produce a corresponding pull on the electric coils of the receiving instrument so as to move the levers, links and pen in such a way that the latter occupies the position on the writing pad exactly corresponding to the position of the transmitting pencil at the other end of the line.

For use inside of a building where long line wire is not necessary, it is customary to use what is known as the three-wire instrument. Two of these wires carry the main operating currents, while the third wire is used for lifting the pen away from the paper, while not writing, as for instance, the spacing between words. The electricity to operate the instrument comes from the ordinary direct-current, 110-volt lamp circuit. Direct current is necessary so that if the building is equipped only with alternating current it is necessary to use a motor dynamo for the transformation of the alternating current to direct. It must be borne in mind that the two coils operating the two swinging levers of the receiver are entirely independent of each other from the electrical standpoint. They are connected only through the levers and links leading to the pen, and even then the motion of one lever has no effect upon the other one, this effect being confined only to the resultant position of the pen itself.

Transmitting the Message

Variable voltage obtained from the constant-voltage electric light circuit forms the means of transmitting the variable currents and to obtain this variable voltage the electric current is passed from the electric light mains through two resistance coils in the transmitter. These resistance coils, of German silver wire, are wound upon horn-shaped frames, the wire when first wound on being insulated and the turns placed side by side as closely as the fine-silk insulation will allow. After having been wound the concave curved surface of the wire-covered horn is covered with glue and, after drying, the insulation of this curved surface of all the wires forming the coils is scraped off, baring the surface of the wires. The different turns are, however, still separated from each other by what is left of the insulation between the wires and also by the glue. These bare wire surfaces, it will be seen, form a very large number of steps in a resistance rheostat and by making contact with any one of these turns in the coil a voltage may be obtained whose value will depend upon the resistance between the point of contact and the positive lead of the coil. The other end of the contacting wire is, of course, led back to the negative side of the power line after passing through the rheostats.

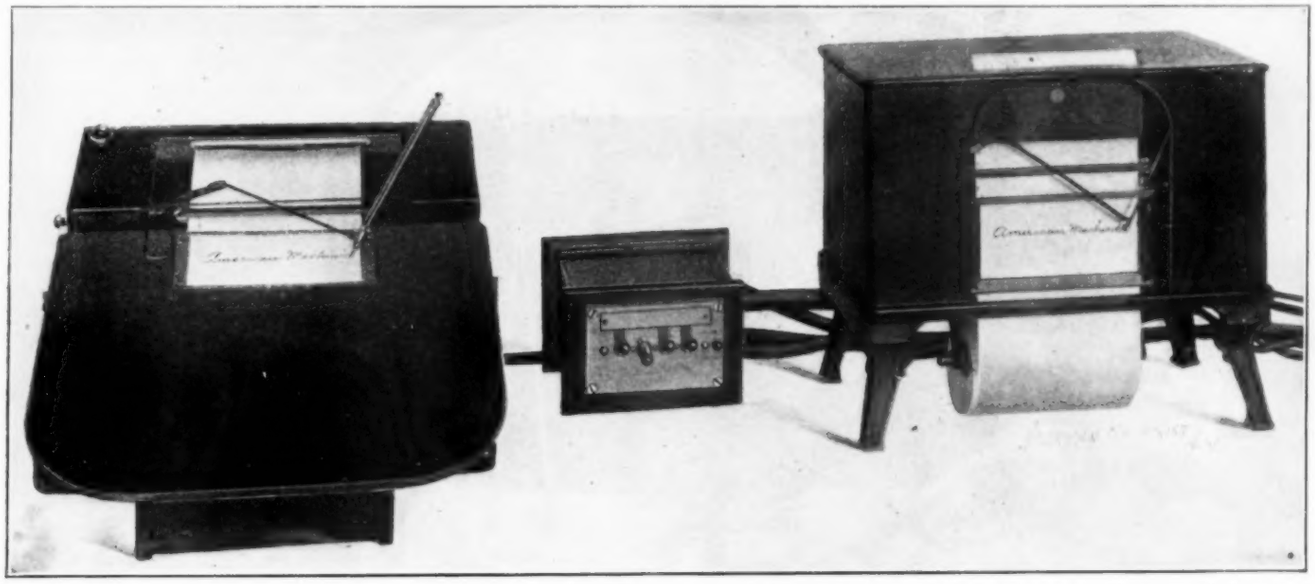


FIG. 3. TRANSMITTER AND RECEIVER WITH SMALL OFFICE SWITCH

The bare surfaces of the rheostat coils are curved in a circular arc so that the contacting wire may swing about a center, as this contactor is composed of a small brass wheel on the end of a lever. The wheel travels back and forth along the resistance coil as the lever is swung about its center. There are two of these resistance coils and two contacting levers and to each one of these levers a link is connected, the links finally joining at the point of the pencil with which the message is written by the transmitter.

Thus it is seen that both the transmitter and receiver in external appearance are a good deal alike; that is, there is a writ-

ing pen or pencil at whose point two links unite at an angle varying with the position of the writing pen or pencil, but approximately at right angles, as long as the writing instruments are within the area of the writing pad. These links are connected to the two swinging levers, which in the receiver are operated by the movable electric coils, and in the transmitter are connected to the swinging contact arms traveling over the rheostat surfaces. Now it will be understood that for given positions of the writing pencil, the contactors of the two rheostats in the transmitter occupy definite positions on the wires of the rheostats, and consequently a certain definite voltage is impressed upon each side of the operating line, these two sides being entirely independent from each other. This voltage, producing currents in the movable coils of the receiving instrument, causes a magnetic pull corresponding definitely to the actual position of the rheostat arms of the transmitter. The magnetic field in which the movable coils in the receiving instrument are suspended is produced by an electromagnet which is very strongly magnetized and whose magnetism does not vary with the position of either the pencil or the pen. As the pencil of the transmitter is moved over the paper by the sender the receiving instrument will follow this motion so as to reproduce the writing or mark or curve in almost exactly its original form, the reproduction as already said, being so remarkably faithful that the handwriting of the sender can be recognized without doubt.

Making the Spaces

In the three-wire instrument the third wire is connected to a contact underneath the platen holding the paper of the transmitting instrument. When the pressure of the writing pencil upon this platen is removed a contact is made and a direct electric current is sent out to the receiving instrument, which operates an electromagnet to pull forward a small guard bar which will then hold the pen away from the surface of the paper. This provides for spaces between words. When the transmitter pencil is pressed upon the platen, breaking the circuit over the third wire, the lifting magnet drops back so that the pen may rest upon the paper to write.

Anti-friction Bearings

It is found with these machines, which, of course, depend upon the greatest delicacy of motion, that friction in the parts must be avoided as much as possible. The mechanical construction is such as to eliminate this friction to a marked degree, but even beyond this it has been found that some electrical means must be employed to this end. It is well appreciated that when a very light instrument sticks in its motion a little vibration will often assist it on its way. This is the principle which is used in these instruments for eliminating the friction of the various moving parts.

In the receiving apparatus there is an interruptor similar to the interruptor of an electric bell, this interruptor being placed in the circuit of one side of the electromagnet forming the permanent magnetic field of the receiving instrument. The other coil of the magnet carries a continuous current from the main power line of the electric-light circuit, this current, as already said, being entirely independent of the operating current sent out over the transmitting line from the transmitter. The side of the electromagnet in whose coil is placed the interruptor is, by this means, supplied with an intermittent current, the intermissions, of course, being of an exceedingly high rate of speed. This rapidly interrupted current on one side of the magnet causes a slight vibration in the magnetic field, and this vibration is sufficient to keep all the moving parts of the receiving apparatus in a continuous, although not violent, pulsation, which practically eliminates any effects of friction. It is to this feature that the instrument owes its remarkably faithful reproduction of handwriting.

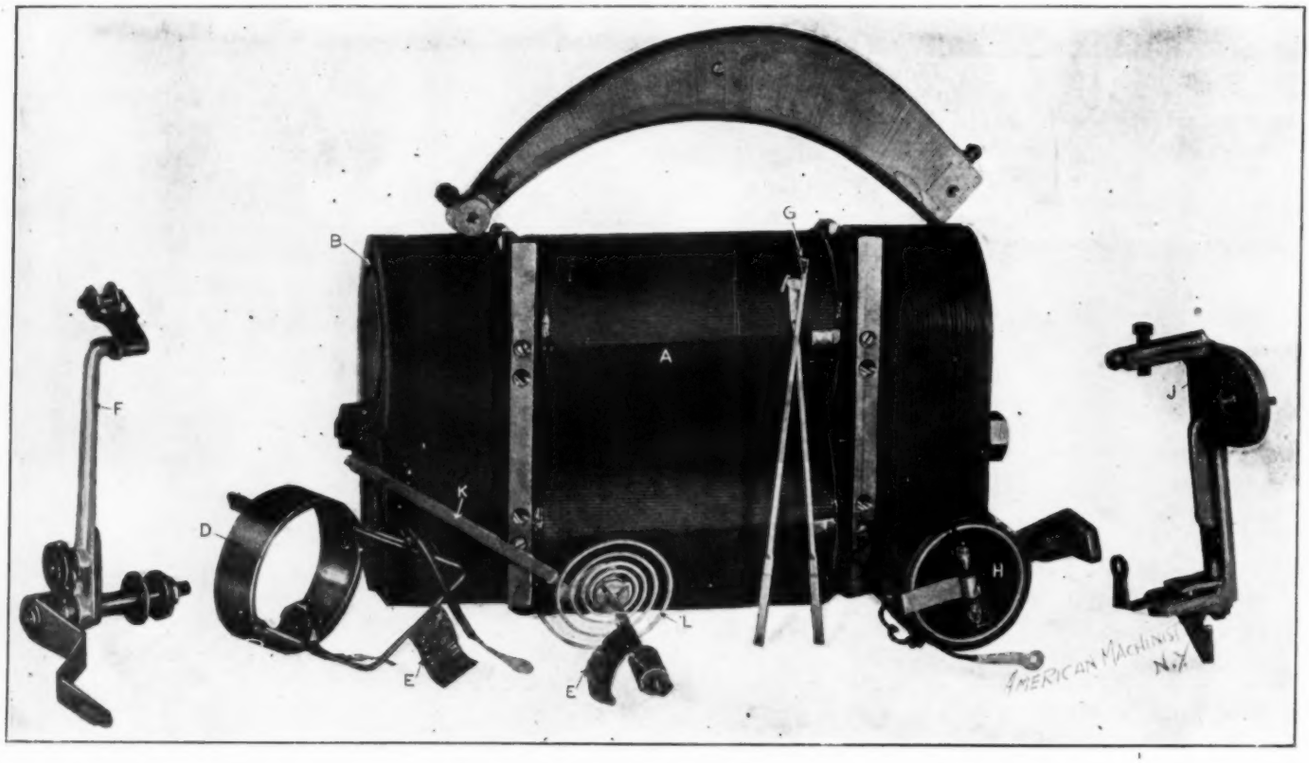


FIG. 4. PARTS OF RECEIVER AND TRANSMITTER

A, main electromagnet of receiver. *B*, annular coil space. *C*, rheostat coil transmitter. *D*, movable coil of receiver. *E*, chain between coil and lever. *F*, contactor of transmitter. *G*, pen and links of receiver. *H*, vibrating platinum contacts for pen lifting in receiver. *J*, lever bracket of receiver. *K*, swinging lever of receiver. *L*, spring of receiver lever.

Pen Lifting on Outside Two-wire Lines

For external lines, as from one building to another, an arrangement is made by which the third, or pen-lifting wire, is done away with. Two wires are not only simpler, but this arrangement makes it possible to utilize existing telephone cables for writing purposes. To do away with the third wire the vibrating principle is

again applied. In the transmitting instrument is a "buzzer" coil in connection with an electric condenser which, by the alternate pressing down and raising up of the sending pencil on the platen causes the flow and stoppage of two equal alternating currents on the regular-line wires, these alternating currents being superimposed upon the variable direct currents sent out to move the pen of the receiving instrument.

At the receiving instrument the superimposed alternating currents do not affect the moving pen coils but cause the vibration of two small platinum electric contacts in a sealed glass tube. When these contacts are vibrated a local direct-current circuit passing through the pen-lifting magnet is cut off and the guard bar drops back allowing the pen of the receiver to write. When, however, the pencil of the transmitter is lifted up the superimposed alternating currents are cut off, the vibration of the platinum contacts in the receiver ceases and the local current flows through the pen-lifter magnet, holding the pen away from the paper in obedience to the similar movement of the transmitting pencil.

No Ink Slinging

When the transmitter is not in use there is a switch which can be thrown to cut off the electric current from the line so that the instruments at both ends are entirely dead. An ingenious safety arrangement of this switch has been added to the machines as now built. It will be realized that if the pencil of the transmitter were out in position upon the writing pad, before any current was turned on and the pen of the receiving instrument, due to its springs, was over at the left-hand side resting in the ink, the sudden application of electric current would cause the coils in the receiver to instantly jump, pulling the pen out of the ink bottle and locating it in the position on the writing pad corresponding exactly to that of the pencil in the transmitter. This jump, which is very sudden, would cause jarring of the apparatus, and furthermore, the throwing out of the ink from the pen so that it would not be able to write its message.

To prevent this sudden jumping it is so arranged that the most convenient method of throwing the switch upon the transmitting instrument is by pressing the pencil point through a small opening in the top of the writing desk. This is the most natural movement in the world and the location of the switch corresponds to the position of the pen on the receiving instrument as it rests naturally in the ink bottle when no current is flowing. Consequently there is no sudden jump when the current is turned on as the pen and the pencil start their motions from the same relative positions. After the current has been turned on, the motion of the pencil over into the writing field causes the pen also to follow in its natural movement without any jerk and without throwing the ink from the pen.

Getting a Line

Movement of the paper upon which the message is written is also accomplished in a very simple manner. The paper in each instrument is wound in rolls and after crossing the writing space the paper goes under a clamp which is electrically operated to both grip and pull the sheet in one movement so as to shift a new section into the writing field. The shifting in both instruments is done by the movement of the main switch to turn on the current, this turning on of the current operating a relay which controls the shifting clamp causing the paper in each instrument to be set forward a distance equal to one line. The writing space is about 2 inches high and 5 inches wide so that there is room for three or four lines of writing. By alternately pushing down and lifting up on the main switch of the transmitter the paper may be forced ahead a number of steps corresponding to any number of lines desired, so that the spacing of the writing is entirely subject to the will of the writer.

Talking Back

It is perfectly possible by having a transmitter and receiver at each end to write in either direction. Of course, it is impossible for two persons to write at the same time with any intelligent results, just as is the case with the telephone. Moreover, to prevent two people from writing at once in the telautograph, there is a small electrical lock in each receiving instrument which is operated by the corresponding transmitter at the other end, so that the second transmitter is electrically locked out of circuit and has no control over the mechanism. The person who gets the other transmitter locked first has the privilege of writing first. If both lock at the same time neither one can transmit any message.

In cities where there are telephones, which in these days means every possible location, it is customary to make arrangements with the telephone companies to use their cables. In this way the cost of the installation for either overhead or underground wires is taken care of by small monthly payments to the Telephone Company. It can also be so arranged as already said that central offices may be installed to allow any number of instruments to be interconnected just as with a telephone system. The wires may also be used for telephone service when not writing, so that the latter feature may be reserved for accurate figure work or for leaving a message for an absentee.

Dipping the Pen

Inking of the pen is accomplished in a very ingenious, although ancient method. The ink bottle is provided with a tight rubber cork, and there is also a hole in the bottle on one side, near the bottom. When this bottle has been filled with ink, the latter cannot run out of the hole as long as the rubber cork is placed tightly in the mouth of the bottle, because the ink is held in by the atmospheric pressure. When the writing pen is released, from the electric influence it is drawn back by its springs and suitable stops, so as to rest in the off position, which corresponds to the hole in the side of the ink bottle, into which the idle pen dips. This happens every time the paper is shifted by pressing the writing pencil upon the master switch in the transmitter and as the pen also dips continuously into the ink when not in use, it is always in good condition to write.

Contrary to what would be expected practically no restriction is placed upon the writer of the message by the links leading from the end of the writing pencil. A very little use of the instrument soon causes the writer to forget that the pen is at all restricted and the handwriting is not affected to a perceptible extent.

Insurance of Transmission

Another ingenious arrangement which is attached to the modern transmitting instrument is a small electric light which burns only when the master switch is properly thrown, the current flowing and the instrument working. In this way it is assured that the writer does not forget to turn on the current before writing and consequently by this means the transmission of his message is assured. For some systems, especially in hotels it is customary to place a receiver at each end, the receivers being in series and controlled from the same writing pencil, so that the writer not only sees his own message written on the pad under his hand, but also sees it reproduced in the instrument before him. The latter being in series with the receiving instrument at the far end of the line, will tell him instantly whether or not his message is being properly transmitted. In fact, in some hotel installations the central office operators are not provided with any writing paper at all under the pencil, they simply write upon a metallic platen, and by looking in front of them slightly overhead, they see their own handwriting reproduced in a receiver which is in series with the receiver at the far end.

Proper signal bells and push buttons are, of course, incorporated in the apparatus just as in the telephone so that before a message is sent the sender may call attention to the person at the other end of the line indicating that a message is being transmitted. If, however, no one happens to be present and the message does not require immediate attention, it is simply left on record in the machine and examined as soon as the attendant at the receiving end returns to his position.

Precaution against overtravel of the parts of the receiving apparatus due to inertia produced by the motions of a quick

writer, is secured by winding the small movable coils in the receiving apparatus upon thin copper sleeves, the effect of the movement of which in the strong magnetic field of the main magnet being the production of eddy currents in these copper sleeves. These eddy currents so damp the movement of the coils that they will stop moving as soon as the movement of the pencil ceases, this insuring that the movements are free from inertia disturbances and are consequently true reproductions.

S. B. R.

Two Railroad Shop Jobs

One of the jobs that every railroad repair shop has constantly on hand is the babbitting of crossheads, and there are many varieties of jigs and fixtures made for this purpose. One of the most complete fixtures we have seen in this line is at the Trenton shops of the Pennsylvania railroad, Trenton, N. J., and which, through the courtesy of master mechanic Maxfield and superintendent of motive power Hayward, we illustrate in Figs. 1 and 2.

As will be seen from Fig. 1, it consists of a base plate carrying a centering plug or arbor and the two angle plates for the babbitting molds themselves. The centering plug is turned to the taper in the crosshead, and after the crosshead is put in place, as in Fig. 1, the angle plates are moved up against the crosshead shoe and

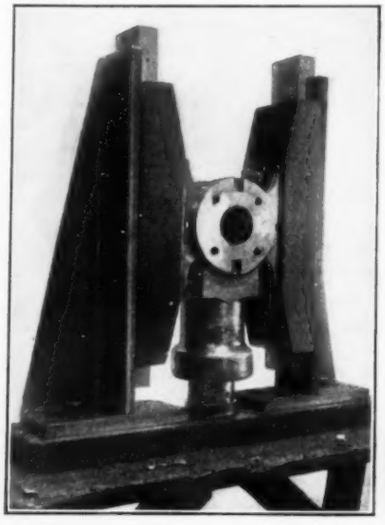


FIG. 1. A CROSSHEAD IN PLACE

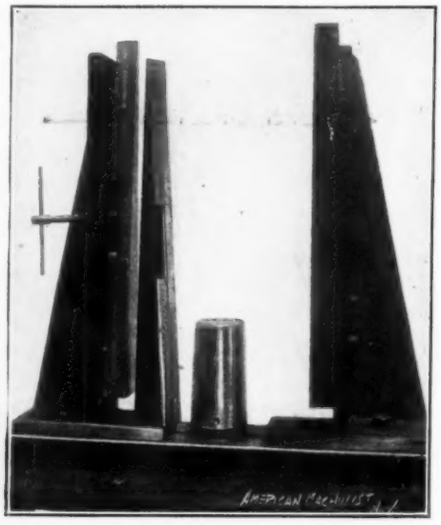


FIG. 2. THE ADJUSTING STRIPS

the inside or distance pieces regulate it according to the width of the crosshead and the guide on which it runs.

Instead of having guides of different sizes, these are made adjustable for any width needed, the details of this being shown in Fig. 2, where the distance piece at the left has been taken apart for this purpose. These distance pieces are composed of two parts having an angular joint, provided with a tongue and groove to insure alinement, and each carrying a short rack into which the small pinion meshes. These distance pieces are connected to the angle plate by bolts, as can be seen in Fig. 1, these bolts playing in slots to allow easy adjustment.

It will readily be seen that by turning the key at the back these distance pieces are moved past each other until the desired width is obtained, after which they are locked in position by drawing up the bolts which reach through the angle plates. This makes a very complete babbitting jig and one which answers for almost any crosshead that comes along, if a centering plug be made to accommodate the different sizes, should they exist.

Finishing Long Staybolts

The method of finishing long staybolts in these shops is shown in Fig. 3, a Pratt & Whitney open turret being used for this work. Staybolts of this kind are forged with a square projecting from the head end, both for screwing them into place and for driving while being cut. Special box tools are made for turning these on the ends before threading and there is also the special steady rest used to guide them as near the end as possible. The front cutters of the box tool turns the outside of the threaded portion, while the last cutter faces and chamfers the end ready for the die.

After this is done the circular formed

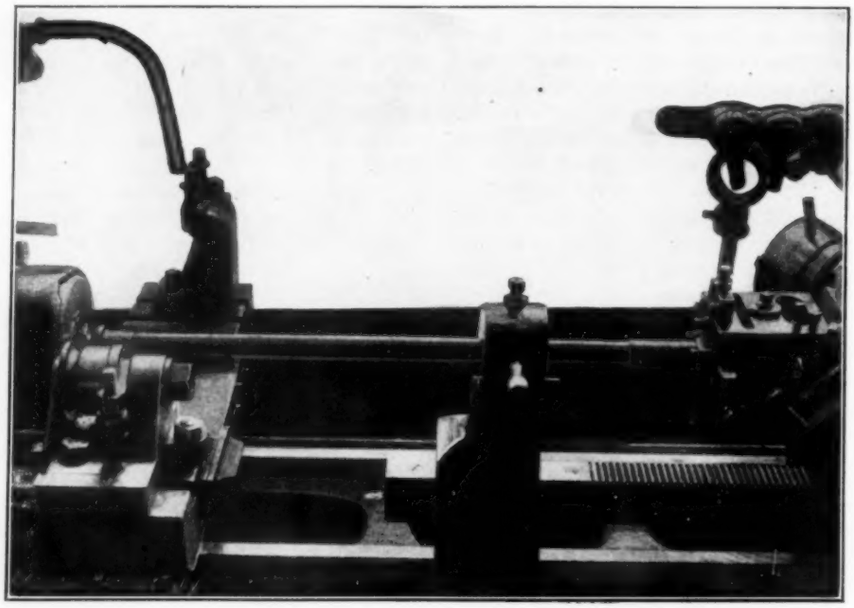


FIG. 3. TURNING A STAYBOLT AT ONE SETTING

tool shown at the front of the cross-slide comes into play and turns the bolts to the correct diameter under the head and at the same time gives the head its round form and undercuts the square end next the head so as to be easily broken off after the stay bolt has been screwed into place.

Fig. 4 shows the staybolts in the rough and after being finished, as well as the form of box tools used. By referring to this drawing it will be seen that the box tool has two cutting tools, one at the front for turning and the other at the rear for facing, both having directly opposite and above their cutting edges a pair of back-rest jaws located at 90 degrees to each other, the front jaws being of rectangular form, while those for the rear tool are cylindrical, as seen at *A*, the details showing the form and means of adjustment quite clearly. One face of jaw *A* is flatted, as indicated, in order to contact with the side of a pin driven in the holder, which prevents the back-rest jaw from rotating in its seat when adjusted by the threaded plug *B*. The latter is connected with the shank at the upper end of jaw *A* by a small pin driven in crosswise and fitting the half-round groove in neck *A*. When properly adjusted screw plugs *B* are securely clamped by check nuts *C* and *D*. The method of adjusting and clamping the outer pair of back-rest jaws and the adjustment for the tool are clearly

shown in the end view. This also illustrates the swinging strap *E* which allows the cutting tool to be readily removed or replaced.

The Proper Place for Laziness

By Con Wise

I am convinced that if we were lazy enough we would not have to work so hard to get to the automobile-owning stage of the game. The contradiction in this statement is only seeming. Most of our trouble and work in this world come about through our disposition to work a little harder with our hands to save ourselves the trouble of thinking. It takes quite a little experience to teach a boy that it pays to stop work and file a saw or sharpen a chisel. In fact, I suspect that half our carpenters, if they were working for themselves, would do neither until the tools refused to cut at all.

The real thing that is bothering me now is the question of just how much work I ought to do. For the sake of disguising the real case we will assume that I am some other man who can do certain work (class A) at which he can earn $5 an hour; he can do certain other work at which he can earn $2 an hour. Still another variety nets him 50 cents an hour, and the last profits him only 20 cents.

Now, it is perfectly apparent that he should work all the time at $5 an hour, and if he has any other work to be done about the premises that he should have it done. The perfectly apparent part sinks into obscurity, though, when we discover that there is not enough $5-an-hour work to keep him busy all the time, and if there was, he could not keep at it all the time without growing stale, so that his value would drop to $2 per hour; also he cannot hire 20-cent-an-hour labor to do 20-cent-an-hour work without spending half his time watching it. Moreover, the nervous wear and tear and the mental anguish caused by watching a 20-cent-an-hour man trying to do 20-cent-an-hour work will reduce his ability to do $5-an-hour work even when it offers.

The reason why a 20-cent-an-hour man is not efficient when left to himself is stated in the first paragraph, so here we are back where we began, like the kitten chasing its tail. The reason why we cannot all earn the top price that we are capable of is because most of us do our work so unintelligently that we have to be watched. I don't think that we ought to be blamed for it though. The trouble is all in the system. When we were in school, at home, or in the shop, it was always "do this," or "don't do that," and if we asked why the only reason we got was that the boss or the teacher was bigger than we were. And they kept it up that way long after we were babies and could be spanked.

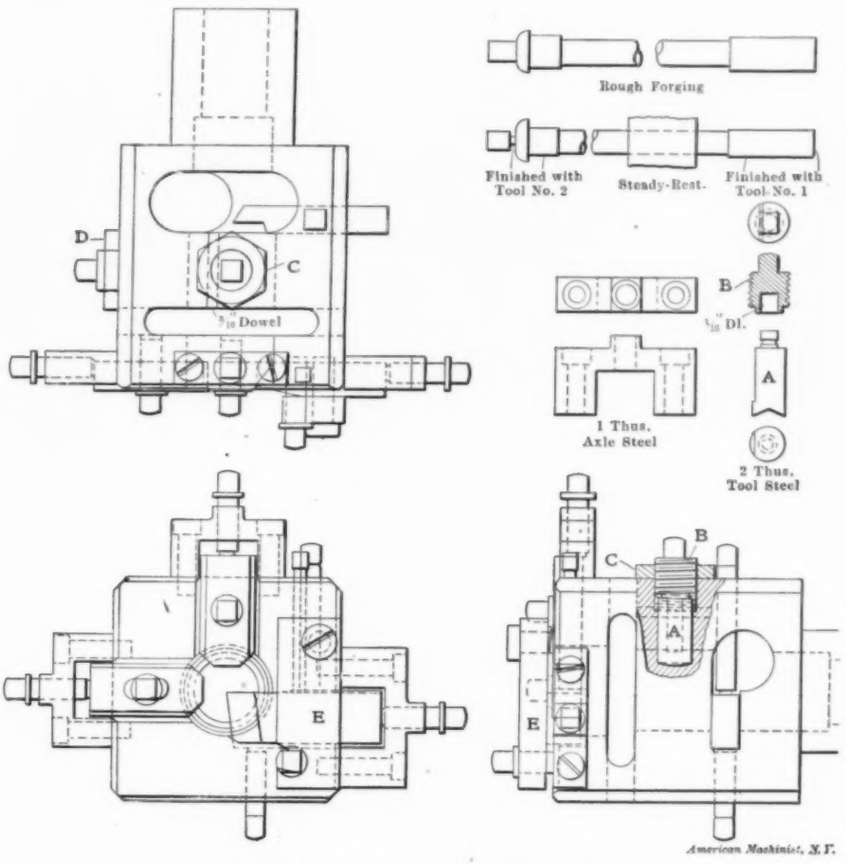


FIG. 4. DETAILS OF THE BOX TOOLS

Ridiculousness of Female Teachers for Boys

There is no more ridiculous sight than to see a little five-foot-two teacher stand up and bulldoze 20 husky chaps that have a right to vote. They stand for it, though, even in this country of the free and the brave. I was fortunate enough to go to school, when I was a lad, out in the country where if the teacher said he could run things he had to prove it. The man teacher that we had was afterward promoted to be head expeller in a saloon. After they found that men could not teach there they hired a woman. You can't argue with a woman the same as you can with a man, and the school deteriorated into a near-seat of learning. Now that the boys cannot take the teacher out and duck him in a snow drift they have to haze each other to keep their hands in. Sometimes they get careless and there are dismal endings. It was better when they had an older and tougher person—the teacher—to handle.

Nowadays the boy that gets out of school into a shop is a meek and lowly chap alongside of the boy of 20 years ago. He is easier for us to handle, because he expects to be ordered about; but the results of the handling are disappointing. He either continues meek and does as he is told, particularly when he knows he has been told wrong, or else he becomes mulish and never does as he is told except when he knows he has been told wrong. Either kind is not a circumstance to the boy who used to want to know why "he had got to do that that way" before he would let go of the foreman. Those boys were rougher material, but they stood the cutting better than the boys of today. That is one of the reasons why technical graduates, with all their faults, get on as well as they do; they do have an idea that the reason why is an important thing to know.

The Value of Time

Speaking of technical graduates; one of the most pronounced failings of these boys is in their entire lack of appreciation of the value of time. If our technical schools would substitute for the Rah! Rah! Rah! of their school yells something like "Time is money," and hang placards to the same effect about the rooms instead of Elbert Hubbard's interpretations of time-worn platitudes, there might be hopes that they would begin to want to know why; and possibly some day they would find the reason. All of which brings me back to the problem I started out with, and my confession that I do not know the answer; but I do know that the waste of energy in having $5-an-hour men doing 20-cent-an-hour work, if properly conserved, would buy and repair quite a flock of automobiles.

Automatic Punch and Die Construction

By W. J. Kaup

There is nothing new under the sun, but every once in a while there is a new application of some of the old principles that makes it worth while to sit up and take notice, and in no branch of the mechanic arts is this so true as in the tools for cheap production: punch, die and forming tool, automatically operated in combination.

The V. & O. Press Company, of Glendale, L. I., has just completed and is now operating for the first time, the tools for automatically turning out a finished bottle cap and while any one of the tools taken individually might not impress us seriously, it is the method of combination that will make its appeal to the thinking toolmaker, because when a number of forces are combined under one operating head, the system of control must be nearer perfect. In this particular combination 7 distinct operations are recorded simultaneously, although only 5 appear in Fig. 1 as completing the sheet-metal work.

Aside from feeding the metal into the press, the operation is entirely automatic, and what draws the limit at the feeding operation is the kind of material used, tin, and that does not come in continuous strips.

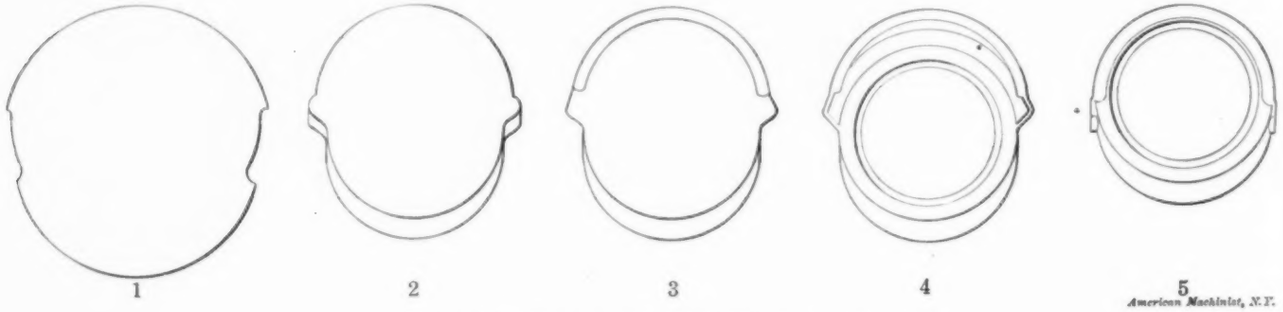


FIG. 1. SEQUENCE OF OPERATIONS ON BOTTLE CAP

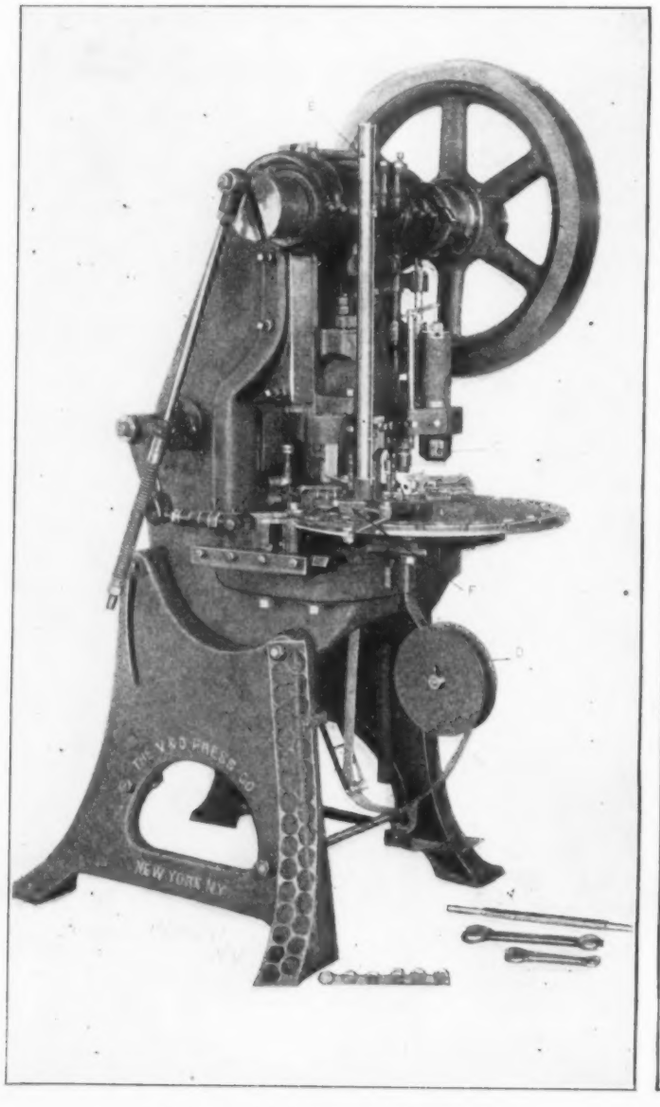


FIG. 2. THE TOOLS IN OPERATION

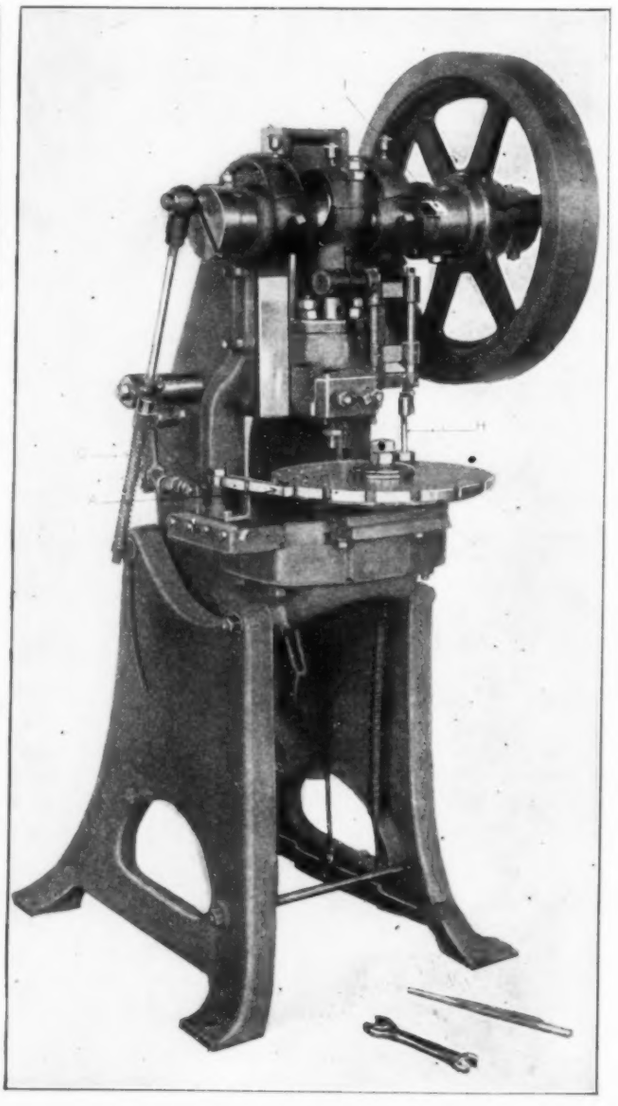


FIG. 3. SAFETY STOP AND FEED MECHANISM

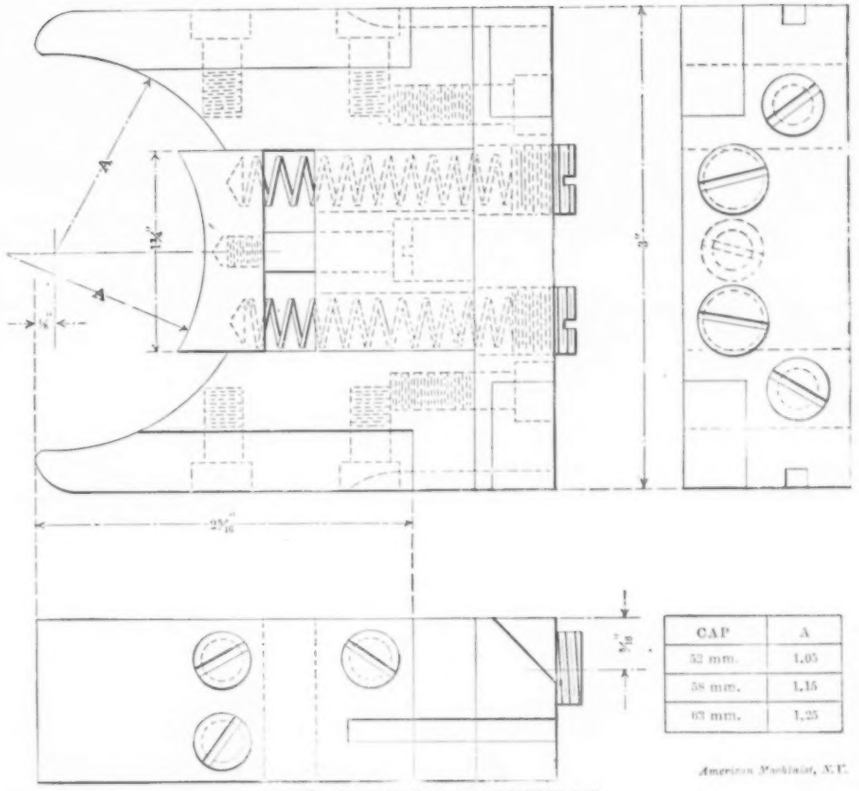
The Machine

This is one of the stock products of this company with rotary dial attachment, as shown in Figs. 2 and 3.

This dial is rotated by means of the side arm and guide as shown in Fig. 3, and controlled by spring pawl *A*, which engages in the notch on the edge of the dial. The dies and forming tools are clamped in circular position as shown in Fig. 4, each tool having a radius *B* common to the dial perforations, which allows for definite location of the dial at each stroke of the press.

The Sequence

The metal is fed into the machine for the first operation which is performed by an inverted compound die *C*, Fig. 2, which blanks the metal and carries it up into the die, which also acts as the forming tool and through the medium of the knockout is left in the rotating dial, which advances it to the next position, immediately under the scoring punch and die, the second operation in the process. Each stroke of the press represents a movement of the dial which carries the punching around in position for each tool to perform its function. The scoring die cuts the metal cap as shown in step 2, Fig. 1, and it is then carried to the folding and beading die which folds the inner edge and beads it as indicated by step 3, Fig. 1. The next operation is perhaps the most interesting of them all. The particular form of the blank indicates a surplus of stock that must at some time be closed in to make it round, and this is done by means of the squeeze die, the details of which are shown in Fig. 5. The central guide with contour of edge corresponding to the periphery of the blank is carried forward by means of a sliding incline or cam, thereby closing the metal so that it conforms to the smaller diameter or bottle size; this leaves the ends projecting; and these are ironed into place by means of the rolls on either side of the forming guide which continue to advance after the central guide has completed its full travel, and by this means the ears are made to conform to the circle. The cap is now ready to be filled and the dial advances it to the next position, where it comes under the paper-disk cutter. The paper is fed automatically from a roll *D*, Fig. 2, across the face of the cap, above which is the die. The punch carries the paper blank through the die into the cap, the dial shifts and it is next in position for the cork disk. The cork is fed from a long tube *E* by gravity feed, and the lever which is operated by the bell crank *F* wipes one disk from the bottom of the tube over into position to be driven home in the shell, a hollow punch, which cups the cork, completes the stroke, carrying the cork with it into the shell, and the next turn of the dial carries it under the knockout pin completed. This takes a long time to tell it but they drop out of the machine at the rate of 90 per minute.



CAP	A
52 mm.	1.05
58 mm.	1.15
63 mm.	1.25

FIG. 5. RIM CLOSER ON SQUEEZE DIE

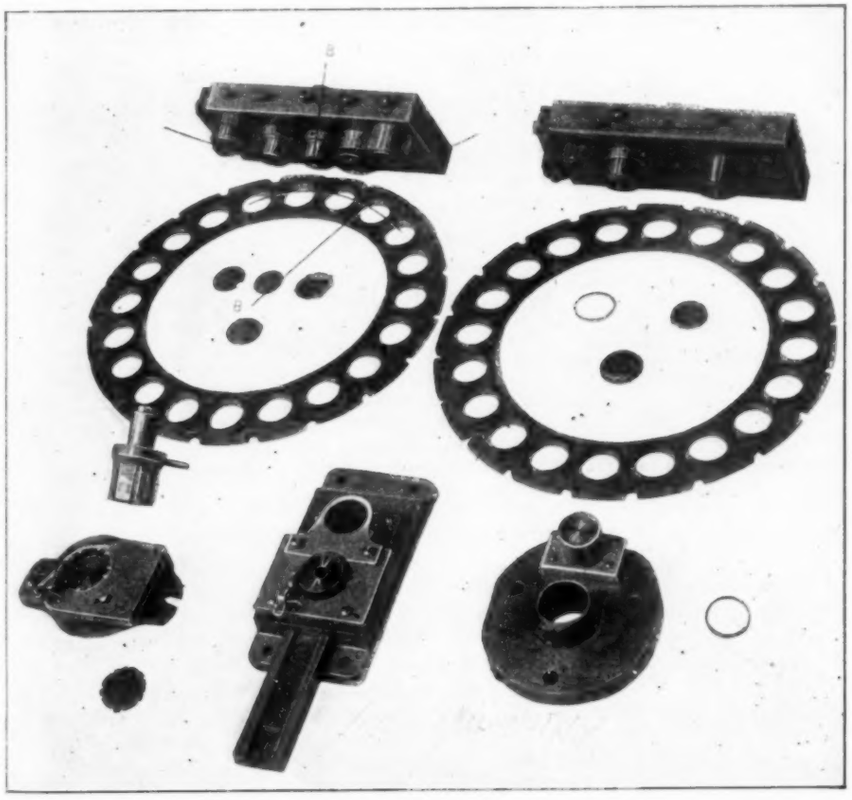


FIG. 4. DIAL CONSTRUCTION

Machine Design

Some interesting features which might be called precautionary machine design are worthy of note, as showing the trend of modern thought toward protection from miscalculation. For instance the dial feed control is so designed that the natural tension of the spring *G*, Fig. 3, feeds the dial. Should the dial become clogged or

cut fast, the press could perform its function, make a complete revolution without breakage of any of the levers, as the spring is long enough to allow for ample compression to allow the wheel to turn free without any movement of the pitman. Fig 3 shows the feed mechanism very clearly.

Another point in addition to this is the means of preventing the shearing of the die by the punch, in case the dial is moved either too far or not far enough. The safety device *H*, as shown in Fig. 3, is an attachment carrying a sliding pin, which fits into the hole in the dial when perfect alinement is made. Failing in alinement, the pin comes down on top of the dial, the ram still continues downward until the extension finger, as shown at *I* in Fig. 3, trips the clutch and the whole mechanism stops, and the wheel turns free.

A Report on Cast Iron Test Bars*

By A. F. Nagle

In machinery castings as well as in cast pipes, separate bars are cast and subjected to tensile or transverse stress, to the breaking point, these results being used as evidence of compliance with the contract specifications. I have examined a large number of such test bars for castings used in the Baltimore sewage pumps and here report the results of this examination and study. Perhaps the most important conclusion is that the test bar is not to be regarded with too much confidence as indicative of the exact strength of the casting.

All transverse bars were nominally 1x2 inches with 24-inch centers. They were cast from two patterns in one mold and made in the same kind of sand as the main casting. The flask was inclined about 30 degrees. There was but one gate for the two bars, with suitable risers. The iron for the bars was poured from a small ladle of iron taken as near as might be from the middle of the pour of the main casting. The breaking loads were corrected for varying dimensions of the bars by the formula

$$W'' = \frac{W' b d^2}{2},$$

where b and d are the actual dimension, W' the actual breaking load, and W'' the corrected load or weight. These results are used throughout this paper. The deflections were not corrected.

The tensile bars, 15/8x6 inches, were cast upright in the same mold as the main casting, within 3 or 4 inches thereof, and connected by an upper and lower gate. The tensile bars were turned to 1¼ inches diameter and threaded, and the middle portion reduced to 1.129 inches diameter, which is equal to 1 square inch area.

*Paper presented at the December meeting of the American Society of Mechanical Engineers.

Table 1 gives the results of the chemical analysis of the several bars tested.

From August 5, 1907, to April 4, 1908, there were made 67 single tensile bars and the same number of pairs of transverse bars, and the average of the latter was used in this record. From April 4 to December 19, 1908, there were made 91 pairs of tensile bars and an equal number of pairs of transverse bars, and each piece of the pair is recorded, instead of the average.

Of these 249 tensile bars and their corresponding transverse bars, 32 sets—26 flat and 6 round—were rejected for defects due to blow holes, and four tensile bars were too hard to bear threading, but the companion piece was used in this record.

Of the 217 specimens here recorded, 42 are designated as abnormal, that is, the ratio between the tensile and the transverse bars was either considerably greater or smaller than the average.

By referring to Table 2, it will be seen that of the 175 specimens of cast iron running from 20,000 to 30,000 pounds tensile strength, the ratio of tensile to breaking loads is practically 10 to 1 and the deflection 0.45 inch.

Table 3 gives 25 abnormal cases where this average ratio is as high as 12.56 to 1 with a deflection of 0.43 inch; also 17 abnormal cases where this average ratio is as low as 7.91 to 1 with a deflection of 0.44 inch. And yet the average of both normal and abnormal bars was again very nearly 10 to 1—10.07 to 1.

Breaking loads, presumably alike, varied in pairs of transverse bars, and also in pairs of tensile bars, as follows: Out of 65 pairs of flat or transverse bars, 14, or 22 per cent., average variation 18 per cent.; 17, or 26 per cent., average variation

Date Cast.	Total Carbon.	Graphite Carbon.	Combined Carbon.	Manganese.	Phosphorus.	Sulphur.	Silicon.	Tensile Strain.	Transverse Load.	Deflection.
Nov. 21, 1907 . . .	3.580	2.830	0.75	0.79	0.485	0.081	1.59	24,900	2,440	0.49
Nov. 26, 1907 . . .	3.396	2.736	0.66	0.38	0.459	0.124	1.91	22,000	2,075	0.40

TABLE 1. ANALYSIS OF CAST-IRON TEST BARS.
Bars Used in I.P. Bed Plate Cast November 21, 1907, and I.P. Frame, Cast November 26, 1907, for Baltimore Sewage Pumps.

Number of Specimens.	Limit of Breaking Load of Transverse Bars.	Breaking Loads, Pounds.		Deflection, Inches.	Ratio of Tensile to Transverse.
		Transverse.	Tensile.		
29	2000 to 2200	2,065	21,630	0.43	10.47 to 1
36	2200 to 2400	2,289	22,940	0.45	10.02 to 1
51	2400 to 2600	2,523	24,880	0.47	9.86 to 1
43	2600 to 2800	2,756	26,500	0.49	9.61 to 1
16	2800 to 3000	2,894	28,460	0.49	9.83 to 1
175	Averages	2,383	23,732	0.45	9.96 to 1

Note.—Transverse bars, rough 2 inch by 1 inch by 24 inch centers: tensile bars, turned 1.129 inch diameter (1 square inch area).

TABLE 2. COMPARISON OF CAST-IRON TEST BARS.

Number of Specimens.	Limit of Breaking Load of Transverse Bars.	Breaking Loads, Pounds.		Deflection, Inches.	Ratio of Tensile to Transverse.
		Transverse.	Tensile.		
Above 10 to 1 ratio					
10	2000 to 2200	2,088	27,143	0.41	12.95 to 1
10	2200 to 2400	2,294	28,530	0.43	12.44 to 1
4	2400 to 2600	2,436	29,600	0.49	12.15 to 1
0	2600 to 2800	00	00		
1	2800 to 3000	2,890	34,000	0.46	11.76 to 1
25	Averages	2,258	28,365	0.43	12.56 to 1
Below 10 to 1 ratio					
1	2000 to 2200	2,105	17,600	0.50	8.36 to 1
4	2200 to 2400	2,359	18,825	0.41	7.98 to 1
7	2400 to 2600	2,487	18,814	0.43	7.57 to 1
3	2600 to 2800	2,656	21,230	0.45	8.00 to 1
2	2800 to 3000	2,969	#24,500	0.47	8.25 to 1
17	Averages	2,521	19,954	0.44	7.91 to 1

TABLE 3. COMPARISON OF CAST-IRON TEST BARS.
Abnormal Results.

5.4 per cent.; 34, or 52 per cent., average variation less than 2 per cent. Out of 65 pairs of round or tensile bars, 22, or 34 per cent. average variation 15 per cent.; 20, or 31 per cent., average variation 5.5 per cent.; 23, or 35 per cent., average variation less than 2 per cent. Sixty-one other pairs of flat bars, which had only one companion tensile bar, varied in about the same ratios.

Two special flat bars and two special round bars, cast in one mold, one gate and at one pour, varied as follows: Two flat bars, 12 per cent.; two round bars, 7 per cent.

In order to get some more definite information on these variations, if possible, I had a pair of transverse and a pair of tensile bars made and cast in the same mold, and while the average ratio of tensile to transverse strength was again nearly 10 to 1, as shown in Table 4, the same type of bars again varied 12 per cent. and 7 per cent., respectively, as shown.

shifting of cores, not a single case of cold shut was discovered. This is in marked contrast with my experience on similar work in other foundries. Excepting a number of steam valves, which were of iron too soft for their purpose, but one large casting, a discharge air chamber weighing 16,000 pounds, was condemned for being of unsatisfactory iron. In this case the iron was coarse grained and brittle, and was required to stand at least 23,000 to 24,000 pounds. To remove all doubt that the test bars were truly representative of the iron in the main casting, two tensile bars were cut out of a large flange, which had been at the bottom of the mold. These, from the most favored part of the casting, as will be seen, stood but about 17,350 pounds; 90 per cent. of that revealed by the test bars. In this case there was a remarkable agreement among these pairs of bars.

It may be interesting to apply these results to the formula for the strength of cast-iron beams subjected to similar stress.

Number of Specimens.	Limit of Breaking Load of Transverse Bars.	Breaking Loads, Pounds.		Deflection, Inches.	Ratio of Tensile to Transverse.
		Transverse.	Tensile.		
1		2,350	23,000	0.50	9.79 to 1
1		2,100	21,470	0.45	10.21 to 1
2	Average	2,225	22,235	0.47	10.04 to 1
217	All Averages	2,380	23,970	0.45	10.07 to 1

TABLE 4. COMPARISON OF CAST-IRON TEST BARS.
SPECIAL, TWO SETS CAST IN SAME MOLD AT SAME TIME.

Bar Mark.	Breaking Loads, Pounds.		Deflection, Inches.	Value of W by Formula Pounds.	Original Diameter, Inches.
	Transverse.	Tensile.			
H	3,344	23,070	0.15	2,948	1.305
H	3,344	23,754	0.15	3,036	1.305
X	3,026	24,670	0.12	3,153	1.300
1	2	3	4	5	6

TABLE 6. CIRCULAR TEST BARS CAST IN VERTICAL DRY-SAND MOLD.

I have no satisfactory explanation for the great variations in these test bars, and we can only accept the fact that mathematical uniformity in strength of cast-iron bars is not found in the present state of the art. To anyone questioning the results I can only say from my own knowledge of the circumstances that the personal equation did not enter into them.

Careful observation of broken bars did not show that the so-called "skin of the metal" was of any appreciable thickness, and the metal was remarkably homogeneous throughout. The tensile bars being turned, the skin, if there were any, of course disappeared. It is my opinion that the skin adds practically nothing to the strength in either transverse or tensile bars, other causes, though obscure, producing far greater deviations.

Although many castings were condemned for physical defects, such as blow holes, shrink holes, sand washes, and

The commonly used formula (Kent, page 268) is:

$$R = \frac{3\,Pl}{2\,bd^2}$$

where R is called the modulus of rupture per square inch of extreme fiber,

P = Load at center,

l = Length in inches between supports,

b and d = Breadth and depth, respectively, in inches.

Making the proper substitutions, we have

$$R = \frac{3 \times 2380 \times 24}{2 \times 2 \times 1 \times 1},$$

or

$$R = 42{,}840$$

pounds. This is not the correct figure, however, for the extreme fiber stress; we know this cannot exceed the tensile strength, which we have found to be 23,732 pounds.

I think it is better to use D. K. Clark's formula, given on page 507 of his "Engineers' Tables," etc.,

$$S = \frac{Wl}{1.155\,bd^2},$$

where S = extreme fiber stress, or tensile strength. If we use the tensile strength found in these tests as 23,732 pounds, the breaking load W would become

$$\frac{23{,}732 \times 1.155 \times 2 \times 1}{24} = 2284$$

pounds, the actual breaking load being 2383 pounds. As this is within 4.3 per cent. of the average found in these tests, this formula, using the tensile strength for the extreme fiber stress, seems to me to be the more intelligible and dispenses with the "coefficient of rupture."

"Mr. Barlow found by experiment that for 1-inch square bars of cast iron, the

Breaking Loads, Pounds.		Deflection, Inches.
Transverse.	Tensile.	
1,968	19,800	0.35
2,019	19,000	0.50
	Cut out of flange	
	17,000	
	17,700	

TABLE 5. TEST BARS FROM CONDEMNED CASTING.

breaking weight in tons [2240 pounds, I presume] was expressed by the formula

$$W = \frac{bd^2}{l} \times 13.6,$$

and Robert Stephenson arrived by experiment at exactly the same coefficient." Clark, page 561.

If we should substitute the value for W found in these tests we would have W', or

$$\frac{2383}{2240}, = 1.064 \text{ tons} = \frac{2 \times 1}{24} \times \text{a constant},$$

or, constant = 12.77, which is within 7 per cent. of the coefficients found by Barlow and Stephenson.

Since the foregoing was written I have had the opportunity to observe two circular test bars nominally 1¼ inches in diameter by 15 inches long, with 12-inch centers. These bars were cast from two patterns in one vertical dry-sand mold and poured from a small ladle, first one and then the other, with the results shown in Table 6.

The tensile bars were taken from the bottom end of the broken test bar, but I do not know whether H or X was poured first. The first tensile bar H had a small air hole, which being corrected for added 7 per cent. to its tensile strength, and this is also given in the table. A second bar was then turned up from the immediate joining piece with the result recorded first in the table. The turned bars were 0.937 inch in diameter. Column 6 gives the original diameter. Column 2 was found by reducing the actual breaking loads in the ratio of the cubes of the diameters, and column 3 was reduced to the square-inch area. Why the transverse breaking

loads should vary 10 per cent. and the tensile bars 4 to 7 per cent. the opposite way, a total variation of 14 to 17 per cent., I leave to the reflection of the reader. If we apply Clark's formula for the breaking weights for circular bars,

$$W = \frac{0.7854 \times d^3 \times S}{l}$$

we find the values given in column 5.

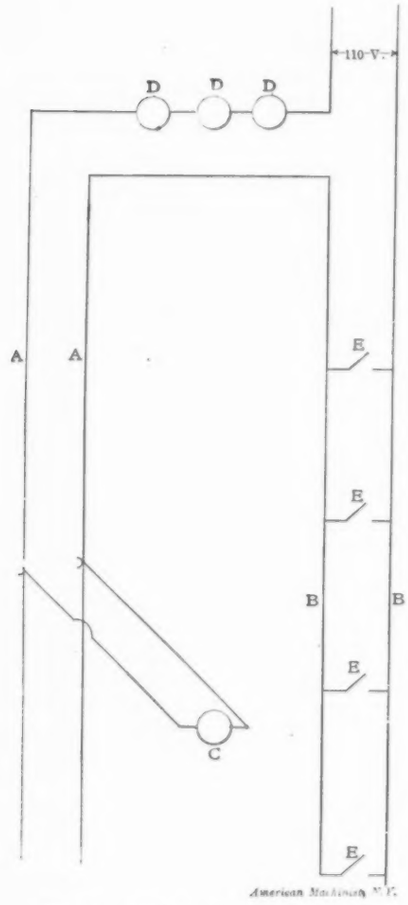


FIG. 1. WIRING DIAGRAM FOR CRANE-SIGNALING DEVICE

In this age of economic production, the cost of these turned tensile bars is frequently objected to by the manufacturer. While blow holes seem to be more frequent in flat transverse bars than in round attached tensile bars, the latter seem liable to a greater abnormal hardness, for which I have no explanation. Some indication of the toughness of cast iron can be seen in its deflection, which is not revealed in a direct tensile pull. I should, therefore, be satisfied with two or three transverse test bars 1x2 inches with 24-inch centers, and a deflection record poured, as near as may be, from the middle of the pour of the main casting, as giving a fair indication of the iron in the main casting, but mathematical exactness cannot be looked for as yet.

If we wish to know approximately the corresponding tensile strength of the iron, we can multiply the breaking load of the 1x2x24-inch flat bar by 10. If the test bar is 1¼ inches diameter with 12-inch centers, its breaking load should be multiplied by 8, to obtain the approximate tensile strength. The general rule seems to be, that where both flat bars agree in breaking loads, the tensile strength is 10 to 1 of the breaking load, but where they differ, the 10 to 1 ratio does not hold. A better practice, therefore, might be to cast three round transverse bars and accept the two that agree, if each is round, as a fair sample of the iron, dispensing with the tensile bars. This concession to the manufacturer, I believe, would entail not only no loss to the city's interests, but a positive gain.

Signal Device for Shop Cranes

By F. E. Sperry

The problem of signaling the crane man, although not a serious problem, is a very difficult one at times, especially where there is considerable noise and confusion. In some shops whistles are resorted to for signaling, but it would seem that this only adds to the confusion in the place. What we need then is a device that depends upon the eye rather than the ear to attract the attention of the operator. The apparatus described below is an electrical device which is in operation in a large machine shop where one crane is doing service in a bay about 300 ft. long.

An extra trolley wire was strung the length of the bay, and connected through trolley riders to the lamp *C*, shown in Fig. 1, which is a diagram of the wiring. This lamp is located directly in front of the crane operator and has a red globe so as not to blind him. Contact that lights the lamp is made by pulling up the semaphore *E*. A large number of semaphores are located conveniently on either side of the bay and in plain view from the operator's cage. The operator himself drops the semaphore after having answered the call. In the particular case from which this was taken, the wires *B B* were poorly insulated and the lamps *D* were introduced to decrease the voltage on the line. The terminals of the circuit were connected to the 110-volt lighting mains.

In Fig. 2 is shown a detail sketch of the semaphore in two positions: at the left in position to signal crane man, and at the right, showing semaphore tripped. This figure also shows the connections of the semaphore to the circuit *B B*. The cord *N* in Fig. 2, enables the workman to raise the signal, while the cord *M* is used by the crane man to drop the semaphore after he has answered the call. The arm of the semaphore is painted white to make it as conspicuous as possible.

A writer in the bulletin of the Massachusetts Institute of Technology calls attention to the fact that electrically connecting a piece of iron with a bronze or copper structure will protect the latter from corrosion, because, owing to the fact that the iron passes into solution, hydrogen will be liberated upon the bronze or copper and its corrosion will thus be prevented. Employing the same reasoning, any metal with a greater tendency to dissolve than iron, for example, zinc, on which the hydrogen is liberated with more difficulty than on iron, should protect the iron at the expense of this other more positive metal. This is the explanation of the well known use of zinc in boilers for the prevention of pitting, and it is but necessary to maintain an electrical connection between the zinc and the iron to insure the complete protection of the latter for a distance which depends upon the electrical conductivity, or purity, of the water in which the two are immersed.

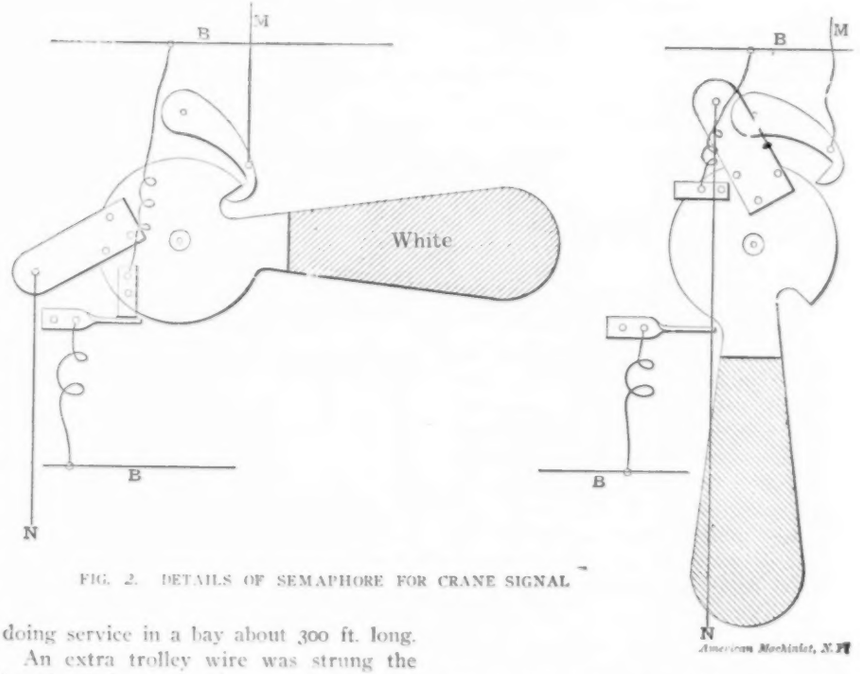


FIG. 2. DETAILS OF SEMAPHORE FOR CRANE SIGNAL

Squares of Numbers Advancing by 64ths from 0 to $7\frac{63}{64}$, by 32ds from 8 to $39\frac{31}{32}$ and by 8ths from 40 to $111\frac{7}{8}$

By W. L. and R. E. Tryon

The accompanying tables should be useful to the drafting room and shop in finding the unknown side of right triangles and other computations. The known sides of triangles are generally given in halves, quarters, eighths, etc., the squares of which are omitted in handbooks.

In calculating the squares given, we have only retained enough decimals to make the tables accurate enough for all drafting-room and shop purposes, as it would be cumbersome to carry them out complete; for example, the square of 1/64 is equal to 0.000244140625. In dropping a portion in squares between $(\frac{1}{64})^2$ and $(\frac{2}{64})^2$, if the seventh-place digit was 5 or over, we added one to the sixth-place digit; between $(1\frac{1}{64})^2$ and $(7\frac{63}{64})^2$, if the sixth-place digit was 5 or over, we added one to the fifth-place digit, etc. The error caused by this method is very small and can be determined for a given mixed number, by finding the difference between the square root of the square given for the mixed number in the table and the given mixed number. This difference, the error, is always less than 0.0001.

These tables were first calculated by each of us by use of the formula

$$(x+y)^2 = x^2 + 2xy + y^2$$

where x was the integral part of the mixed number and y, the fractional part. We then compared the results and where they did not agree, calculated them again. The squares of whole numbers, mixed numbers ending in halves, and as far as possible those ending in quarters, were then compared with Barlow's "Tables of Squares," etc., of all integer numbers up to 10,000.

TABLE I

SQUARES OF NUMBERS
FROM "0" TO "$7\frac{63}{64}$" BY 64THS

NUMBER

Added Fractions to Sixty-fourths

	0	1	2	3	4	5	6	7
0	.000000	1.00000	4.00000	9.00000	16.00000	25.00000	36.00000	49.00000
1/64	.000244	1.03149	4.06274	9.09399	16.12524	25.15649	36.18774	49.21899
2/64	.000977	1.06348	4.12598	9.18848	16.25098	25.31348	36.37598	49.43848
3/64	.002197	1.09595	4.18970	9.28345	16.37720	25.47095	36.56470	49.65845
4/64	.003906	1.12891	4.25391	9.37891	16.50391	25.62891	36.75391	49.87891
5/64	.006104	1.16235	4.31860	9.47485	16.63110	25.78735	36.94360	50.09985
6/64	.008789	1.19629	4.38379	9.57129	16.75879	25.94629	37.13379	50.32129
7/64	.011963	1.23071	4.44946	9.66821	16.88696	26.10571	37.32446	50.54321
8/64	.015625	1.26563	4.51563	9.76563	17.01563	26.26563	37.51563	50.76563
9/64	.019775	1.30103	4.58228	9.86353	17.14478	26.42603	37.70728	50.98853
10/64	.024414	1.33691	4.64941	9.96191	17.27441	26.58691	37.89941	51.21191
11/64	.029541	1.37329	4.71704	10.06079	17.40454	26.74829	38.09204	51.43579
12/64	.035156	1.41016	4.78516	10.16016	17.53516	26.91016	38.28516	51.66016
13/64	.041260	1.44751	4.85376	10.26001	17.66626	27.07251	38.47876	51.88501
14/64	.047852	1.48535	4.92285	10.36035	17.79785	27.23535	38.67285	52.11035
15/64	.054932	1.52368	4.99243	10.46118	17.92993	27.39868	38.86743	52.33618
16/64	.062500	1.56250	5.06250	10.56250	18.06250	27.56250	39.06250	52.56250
17/64	.070557	1.60181	5.13306	10.66431	18.19556	27.72681	39.25806	52.78931
18/64	.079102	1.64160	5.20410	10.76660	18.32910	27.89160	39.45410	53.01660
19/64	.088135	1.68188	5.27563	10.85938	18.46313	28.05688	39.65063	53.24438
20/64	.097656	1.72266	5.34766	10.97266	18.59766	28.22266	39.84766	53.47266
21/64	.107666	1.76392	5.42017	11.07642	18.73267	28.38892	40.04517	53.70142
22/64	.118164	1.80566	5.49316	11.18066	18.86816	28.55566	40.24316	53.93066
23/64	.129151	1.84790	5.56665	11.28540	19.00415	28.72290	40.44165	54.16040
24/64	.140625	1.89063	5.64063	11.39063	19.14063	28.89063	40.64063	54.39063
25/64	.152588	1.93384	5.71509	11.49634	19.27759	29.05884	40.84009	54.62134
26/64	.165039	1.97754	5.79004	11.60254	19.41504	29.22754	41.04004	54.85254
27/64	.177979	2.02173	5.86548	11.70923	19.55298	29.39673	41.24048	55.08423
28/64	.191406	2.06641	5.94141	11.81641	19.69141	29.56641	41.44141	55.31641
29/64	.205322	2.11157	6.01782	11.92407	19.83032	29.73657	41.64282	55.54907
30/64	.219726	2.15723	6.09473	12.03223	19.96973	29.90723	41.84473	55.78223
31/64	.234619	2.20337	6.17212	12.14087	20.10962	30.07837	42.04712	56.01587
32/64	.250000	2.25000	6.25000	12.25000	20.25000	30.25000	42.25000	56.25000
33/64	.265869	2.29712	6.32837	12.35962	20.39087	30.42212	42.45337	56.48462
34/64	.282227	2.34473	6.40723	12.46973	20.53223	30.59473	42.65723	56.71973
35/64	.299072	2.39282	6.48657	12.58032	20.67407	30.76782	42.86157	56.95532
36/64	.316406	2.44141	6.56641	12.69141	20.81641	30.94141	43.06641	57.19141
37/64	.334229	2.49048	6.64673	12.80298	20.95923	31.11548	43.27173	57.42798
38/64	.352539	2.54004	6.72754	12.91504	21.10254	31.29004	43.47754	57.66504
39/64	.371338	2.59009	6.80884	13.02759	21.24634	31.46509	43.68384	57.90259
40/64	.390625	2.64063	6.89063	13.14063	21.39063	31.64063	43.89063	58.14063
41/64	.410400	2.69165	6.97290	13.25415	21.53540	31.81665	44.09790	58.37915
42/64	.430664	2.74316	7.05566	13.36816	21.68066	31.99316	44.30566	58.61816
43/64	.451416	2.79517	7.13892	13.48267	21.82642	32.17017	44.51392	58.85767
44/64	.472656	2.84766	7.22266	13.59766	21.97266	32.34766	44.72266	59.09766
45/64	.494385	2.90063	7.30688	13.71313	22.11938	32.52563	44.93188	59.33813
46/64	.516602	2.95410	7.39160	13.82910	22.26660	32.70410	45.14160	59.57910
47/64	.539307	3.00806	7.47681	13.94556	22.41431	32.88306	45.35181	59.82056
48/64	.562500	3.06250	7.56250	14.06250	22.56250	33.06250	45.56250	60.06250
49/64	.586182	3.11743	7.64868	14.17993	22.71118	33.24243	45.77368	60.30493
50/64	.610352	3.17285	7.73535	14.29785	22.86035	33.42285	45.98535	60.54785
51/64	.635010	3.22876	7.82251	14.41626	23.01001	33.60376	46.19751	60.79126
52/64	.660156	3.28516	7.91016	14.53516	23.16016	33.78516	46.41016	61.03516
53/64	.685791	3.34204	7.99829	14.65454	23.31079	33.96704	46.62329	61.27954
54/64	.711914	3.39941	8.08691	14.77441	23.46191	34.14941	46.83691	61.52441
55/64	.738526	3.45728	8.17603	14.89478	23.61353	34.33228	47.05103	61.76978
56/64	.765625	3.51563	8.26563	15.01563	23.76563	34.51563	47.26563	62.01563
57/64	.793213	3.57446	8.35571	15.13696	23.91821	34.69946	47.48071	62.26196
58/64	.821289	3.63379	8.44629	15.25879	24.07129	34.88379	47.69629	62.50879
59/64	.849854	3.69360	8.53735	15.38110	24.22485	35.06860	47.91235	62.75610
60/64	.878906	3.75391	8.62891	15.50391	24.37891	35.25391	48.12891	63.00391
61/64	.908447	3.81470	8.72095	15.62720	24.53345	35.43970	48.34595	63.25220
62/64	.938477	3.87598	8.81348	15.75098	24.68848	35.62598	48.56348	63.50098
63/64	.968994	3.93774	8.90649	15.87524	24.84399	35.81274	48.78149	63.75024

TABLE II

SQUARES OF NUMBERS
FROM "8" TO "23 31/32" BY 32NDS

NUMBER

Added Fractions to Thirty-seconds	8	9	10	11	12	13	14	15
0	64.0000	81.0000	100.0000	121.0000	144.0000	169.0000	196.0000	225.0000
1/32	64.5010	81.5635	100.6260	121.6885	144.7510	169.8135	196.8760	225.9385
1/16	65.0039	82.1289	101.2539	122.3789	145.5039	170.6289	197.7539	226.8789
3/32	65.5088	82.6963	101.8838	123.0713	146.2588	171.4463	198.6338	227.8213
1/8	66.0156	83.2656	102.5156	123.7656	147.0156	172.2656	199.5156	228.7656
5/32	66.5244	83.8369	103.1494	124.4619	147.7744	173.0869	200.3994	229.7119
3/16	67.0352	84.4102	103.7852	125.1602	148.5352	173.9102	201.2852	230.6602
7/32	67.5479	84.9854	104.4229	125.8604	149.2979	174.7354	202.1725	231.6104
1/4	68.0625	85.5625	105.0625	126.5625	150.0625	175.5625	203.0625	232.5625
9/32	68.5791	86.1416	105.7041	127.2666	150.8291	176.3916	203.9541	233.5166
5/16	69.0977	86.7227	106.3477	127.9727	151.5977	177.2227	204.8477	234.4727
11/32	69.6182	87.3057	106.9932	128.6807	152.3682	178.0557	205.7432	235.4307
3/8	70.1406	87.8906	107.6406	129.3906	153.1406	178.8906	206.6406	236.3906
13/32	70.6650	88.4775	108.2900	130.1025	153.9150	179.7278	207.5404	237.3535
7/16	71.1914	89.0664	108.9414	130.8164	154.6914	180.5664	208.4414	238.3164
15/32	71.7197	89.6572	109.5947	131.5322	155.4697	181.4072	209.3447	239.2822
1/2	72.2500	90.2500	110.2500	132.2500	156.2500	182.2500	210.2500	240.2500
17/32	72.7822	90.8447	110.9072	132.9697	157.0322	183.0947	211.1572	241.2197
9/16	73.3164	91.4414	111.5664	133.6914	157.8164	183.9414	212.0664	242.1914
19/32	73.8525	92.0400	112.2275	134.4150	158.6025	184.7900	212.9775	243.1650
5/8	74.3906	92.6406	112.8906	135.1406	159.3906	185.6406	213.8906	244.1406
21/32	74.9307	93.2432	113.5557	135.8682	160.1807	186.4932	214.8057	245.1182
11/16	75.4727	93.8477	114.2227	136.5977	160.9727	187.3477	215.7227	246.0977
23/32	76.0166	94.4541	114.8916	137.3291	161.7666	188.2041	216.6416	247.0791
3/4	76.5625	95.0625	115.5625	138.0625	162.5625	189.0625	217.5625	248.0625
25/32	77.1104	95.6729	116.2354	138.7979	163.3604	189.9229	218.4854	249.0479
13/16	77.6602	96.2852	116.9102	139.5352	164.1602	190.7852	219.4102	250.0352
27/32	78.2119	96.8994	117.5869	140.2744	164.9619	191.6494	220.3369	251.0244
7/8	78.7656	97.5156	118.2656	141.0156	165.7656	192.5156	221.2656	252.0156
29/32	79.3213	98.1338	118.9463	141.7588	166.5713	193.3838	222.1963	253.0088
15/16	79.8789	98.7539	119.6289	142.5039	167.3789	194.2539	223.1289	254.0039
31/32	80.4385	99.3760	120.3135	143.2510	168.1885	195.1260	224.0635	255.0010

NUMBER

Added Fractions to Thirty-seconds	16	17	18	19	20	21	22	23
0	256.000	289.000	324.000	361.000	400.000	441.000	484.000	529.000
1/32	257.001	290.063	325.126	362.188	401.251	442.313	485.376	530.438
1/16	258.004	291.129	326.254	363.379	402.504	443.629	486.754	531.879
3/32	259.009	292.196	327.384	364.571	403.759	444.946	488.134	533.321
1/8	260.016	293.266	328.516	365.766	405.016	446.266	489.516	534.766
5/32	261.024	294.337	329.649	366.962	406.274	447.587	490.899	536.212
3/16	262.035	295.410	330.785	368.160	407.535	448.910	492.286	537.660
7/32	263.048	296.485	331.923	369.360	408.798	450.235	493.673	539.110
1/4	264.063	297.563	333.063	370.563	410.063	451.563	495.063	540.563
9/32	265.079	298.642	334.204	371.767	411.329	452.892	496.454	542.017
5/16	266.098	299.723	335.348	372.973	412.598	454.223	497.848	543.473
11/32	267.118	300.806	336.493	374.181	413.868	455.556	499.243	544.931
3/8	268.141	301.891	337.641	375.391	415.141	456.891	500.641	546.391
13/32	269.165	302.978	338.790	376.603	416.415	458.228	502.040	547.853
7/16	270.191	304.066	339.941	377.816	417.691	459.566	503.441	549.316
15/32	271.220	305.157	341.095	379.032	418.970	460.907	504.845	550.782
1/2	272.250	306.250	342.250	380.250	420.250	462.250	506.250	552.250
17/32	273.282	307.345	343.407	381.470	421.532	463.595	507.657	553.720
9/16	274.316	308.441	344.566	382.691	422.816	464.941	509.066	555.191
19/32	275.353	309.540	345.728	383.915	424.103	466.290	510.478	556.665
5/8	276.391	310.641	346.891	385.141	425.391	467.641	511.891	558.141
21/32	277.431	311.743	348.056	386.368	426.681	468.993	513.306	559.618
11/16	278.473	312.848	349.223	387.598	427.973	470.348	514.723	561.098
23/32	279.517	313.954	350.392	388.829	429.267	471.704	516.142	562.579
3/4	280.563	315.063	351.563	390.063	430.563	473.063	517.563	564.063
25/32	281.610	316.173	352.735	391.299	431.860	474.423	518.985	565.548
13/16	282.660	317.285	353.910	392.535	433.160	475.785	520.410	567.035
27/32	283.712	318.399	355.087	393.774	434.462	477.149	521.837	568.524
7/8	284.766	319.516	356.266	395.016	435.766	478.516	523.266	570.016
29/32	285.821	320.634	357.446	396.259	437.071	479.884	524.696	571.509
15/16	286.879	321.754	358.629	397.504	438.379	481.254	526.129	573.004
31/32	287.938	322.876	359.813	398.751	439.688	482.626	527.563	574.501

TABLE III

SQUARES OF NUMBERS
FROM "24" TO "39 31/32" BY 32NDS

NUMBER

Added Fractions to Thirty-seconds	24	25	26	27	28	29	30	31
0	576.000	625.000	676.000	729.000	784.000	841.000	900.000	961.000
1/32	577.501	626.564	677.626	730.689	785.751	842.814	901.876	962.939
1/16	579.004	628.129	679.254	732.379	787.504	844.629	903.754	964.879
3/32	580.509	629.696	680.884	734.071	789.259	846.446	905.634	966.821
1/8	582.016	631.266	682.516	735.766	791.016	848.266	907.516	968.766
5/32	583.524	632.837	683.149	737.462	792.774	850.087	909.399	970.712
3/16	585.035	634.410	685.785	739.160	794.535	851.910	911.286	972.660
7/32	586.548	635.985	687.423	740.860	796.298	853.735	913.173	974.610
1/4	588.063	637.563	689.063	742.563	798.063	855.563	915.063	976.563
9/32	589.579	639.142	690.704	744.267	799.829	857.392	916.954	978.517
5/16	591.098	640.723	692.348	745.973	801.598	859.223	918.848	980.473
11/32	592.618	642.306	693.993	747.681	803.368	861.056	920.743	982.431
3/8	594.141	643.891	695.641	749.391	805.141	862.891	922.641	984.391
13/32	595.665	645.478	697.290	751.103	806.915	864.728	924.540	986.353
7/16	597.191	647.066	698.941	752.816	808.691	866.566	926.441	988.316
15/32	598.720	648.657	700.595	754.532	810.470	868.407	928.345	990.282
1/2	600.250	650.250	702.250	756.250	812.250	870.250	930.250	992.250
17/32	601.782	651.845	703.907	757.970	814.032	872.095	932.157	994.220
9/16	603.316	653.441	705.566	759.691	815.816	873.941	934.066	996.191
19/32	604.853	655.040	707.228	761.415	817.603	875.790	935.978	998.165
5/8	606.391	656.641	708.891	763.141	819.391	877.641	937.891	1000.141
21/32	607.931	658.243	710.556	764.868	821.181	879.493	939.806	1002.118
11/16	609.473	659.848	712.223	766.598	822.973	881.348	941.723	1004.098
23/32	611.017	661.454	713.892	768.329	824.767	883.204	943.642	1006.079
3/4	612.563	663.063	715.563	770.063	826.563	885.063	945.563	1008.063
25/32	614.110	664.673	717.235	771.798	828.360	886.923	947.486	1010.048
13/16	615.660	666.285	718.910	773.535	830.160	888.785	949.410	1012.035
27/32	617.212	667.899	720.587	775.274	831.962	890.650	951.337	1014.024
7/8	618.766	669.516	722.266	777.016	833.766	892.516	953.266	1016.016
29/32	620.321	671.134	723.946	778.759	835.571	894.384	955.196	1018.009
15/16	621.879	672.754	725.629	780.504	837.379	896.254	957.129	1020.004
31/32	623.439	674.376	727.314	782.251	839.188	898.126	959.064	1022.001

NUMBER

Added Fractions to Thirty-seconds	32	33	34	35	36	37	38	39
0	1024.00	1089.00	1156.00	1225.00	1296.00	1369.00	1444.00	1521.00
1/32	1026.00	1091.06	1158.13	1227.19	1298.25	1371.31	1446.38	1523.44
1/16	1028.00	1093.13	1160.25	1229.38	1300.50	1373.63	1448.75	1525.88
3/32	1030.01	1095.20	1162.38	1231.57	1302.76	1375.95	1451.13	1528.32
1/8	1032.02	1097.27	1164.52	1233.77	1305.02	1378.27	1453.52	1530.77
5/32	1034.02	1099.34	1166.65	1235.96	1307.27	1380.59	1455.90	1533.21
3/16	1036.04	1101.41	1168.79	1238.16	1309.54	1382.91	1458.29	1535.66
7/32	1038.05	1103.49	1170.92	1240.36	1311.80	1385.24	1460.67	1538.11
1/4	1040.06	1105.56	1173.06	1242.56	1314.06	1387.56	1463.06	1540.56
9/32	1042.08	1107.64	1175.20	1244.77	1316.33	1389.89	1465.45	1543.02
5/16	1044.10	1109.72	1177.35	1246.97	1318.60	1392.22	1467.85	1545.47
11/32	1046.12	1111.81	1179.49	1249.18	1320.87	1394.56	1470.24	1547.93
3/8	1048.14	1113.89	1181.64	1251.39	1323.14	1396.89	1472.64	1550.39
13/32	1050.17	1115.98	1183.79	1253.60	1325.42	1399.23	1475.04	1552.85
7/16	1052.19	1118.07	1185.94	1255.82	1327.69	1401.57	1477.44	1555.32
15/32	1054.22	1120.16	1188.09	1258.03	1329.97	1403.91	1479.84	1557.78
1/2	1056.25	1122.25	1190.25	1260.25	1332.25	1406.25	1482.25	1560.25
17/32	1058.28	1124.34	1192.41	1262.47	1334.53	1408.59	1484.66	1562.72
9/16	1060.32	1126.44	1194.57	1264.69	1336.82	1410.94	1487.07	1565.19
19/32	1062.35	1128.54	1196.73	1266.91	1339.10	1413.29	1489.48	1567.67
5/8	1064.39	1130.64	1198.89	1269.14	1341.39	1415.64	1491.89	1570.14
21/32	1066.43	1132.74	1201.06	1271.37	1343.68	1417.99	1494.31	1572.62
11/16	1068.47	1134.85	1203.22	1273.60	1345.97	1420.35	1496.72	1575.10
23/32	1070.52	1135.95	1205.39	1275.83	1348.27	1422.70	1499.14	1577.58
3/4	1072.56	1139.06	1207.56	1278.06	1350.56	1425.06	1501.56	1580.06
25/32	1074.61	1141.17	1209.74	1280.30	1352.86	1427.42	1503.99	1582.55
13/16	1076.66	1143.29	1211.91	1282.54	1355.16	1429.79	1506.41	1585.04
27/32	1078.71	1145.40	1214.09	1284.77	1357.46	1432.15	1508.84	1587.52
7/8	1080.77	1147.52	1216.26	1287.02	1359.77	1434.52	1511.26	1590.02
29/32	1082.82	1149.63	1218.45	1289.26	1362.07	1436.88	1513.70	1592.51
15/16	1084.88	1151.75	1220.63	1291.50	1364.38	1439.25	1516.13	1595.00
31/32	1086.94	1153.88	1222.81	1293.75	1366.69	1441.63	1518.56	1597.50

TABLE IV

SQUARES OF NUMBERS
FROM "40" TO "111⅞" BY 8THS

NUMBER

Added Eighths

	40	41	42	43	44	45	46	47
0	1600.00	1681.00	1764.00	1849.00	1936.00	2025.00	2116.00	2209.00
⅛	1610.02	1691.27	1774.52	1859.77	1947.02	2036.27	2127.52	2220.77
¼	1620.06	1701.56	1785.06	1870.56	1958.06	2047.56	2139.06	2232.56
⅜	1630.14	1711.89	1795.64	1881.39	1969.14	2058.89	2150.64	2244.39
½	1640.25	1722.25	1806.25	1892.25	1980.25	2070.25	2162.25	2256.25
⅝	1650.39	1732.64	1816.89	1903.14	1991.39	2081.64	2173.89	2268.14
¾	1660.56	1743.06	1827.56	1914.06	2002.56	2093.06	2185.56	2280.06
⅞	1670.77	1753.52	1838.27	1925.02	2013.77	2104.52	2197.27	2292.02

	48	49	50	51	52	53	54	55
0	2304.00	2401.00	2500.00	2601.00	2704.00	2809.00	2916.00	3025.00
⅛	2316.02	2413.27	2512.52	2613.77	2717.02	2822.27	2929.52	3038.77
¼	2328.06	2425.56	2525.06	2626.56	2730.06	2835.56	2943.06	3052.56
⅜	2340.14	2437.89	2537.64	2639.39	2743.14	2848.89	2956.64	3066.39
½	2352.25	2450.25	2550.25	2652.25	2756.25	2862.25	2970.25	3080.25
⅝	2364.39	2462.64	2562.89	2665.14	2769.39	2875.64	2983.89	3094.14
¾	2376.56	2475.06	2575.56	2678.06	2782.56	2889.06	2997.56	3108.06
⅞	2388.77	2487.52	2588.27	2691.02	2775.77	2902.52	3011.27	3122.02

	56	57	58	59	60	61	62	63
0	3136.00	3249.00	3364.00	3481.00	3600.00	3721.00	3844.00	3969.00
⅛	3150.02	3263.27	3378.52	3495.77	3615.02	3736.27	3859.52	3984.77
¼	3164.06	3277.56	3393.06	3510.56	3630.06	3751.56	3875.06	4000.56
⅜	3178.14	3291.89	3407.64	3525.39	3645.14	3766.89	3890.64	4016.39
½	3192.25	3306.25	3422.25	3540.25	3660.25	3782.25	3906.25	4032.25
⅝	3206.39	3320.64	3436.89	3555.14	3675.39	3797.64	3921.89	4048.14
¾	3220.56	3335.06	3451.56	3570.06	3690.56	3813.06	3937.56	4064.06
⅞	3234.77	3349.52	3466.27	3585.02	3705.77	3828.52	3953.27	4080.02

	64	65	66	67	68	69	70	71
0	4096.00	4225.00	4356.00	4489.00	4624.00	4761.00	4900.00	5041.00
⅛	4112.02	4241.27	4372.52	4505.77	4641.02	4778.27	4917.52	5058.77
¼	4128.06	4257.56	4389.06	4522.56	4658.06	4795.56	4935.06	5076.56
⅜	4144.14	4273.89	4405.64	4539.39	4675.14	4812.89	4952.64	5094.39
½	4160.25	4290.25	4422.25	4556.25	4692.25	4830.25	4970.25	5112.25
⅝	4176.39	4306.64	4438.89	4573.14	4709.39	4847.64	4987.89	5130.14
¾	4192.56	4323.06	4455.56	4590.06	4726.56	4865.06	5005.56	5148.06
⅞	4208.77	4339.52	4472.27	4607.02	4743.77	4882.52	5023.27	5166.02

	72	73	74	75	76	77	78	79
0	5184.00	5329.00	5476.00	5625.00	5776.00	5929.00	6084.00	6241.00
⅛	5202.02	5347.27	5494.52	5643.77	5795.02	5948.27	6103.52	6260.77
¼	5220.06	5365.56	5513.06	5662.56	5814.06	5967.56	6123.06	6280.56
⅜	5238.14	5383.89	5531.64	5681.39	5833.14	5986.89	6142.64	6300.39
½	5256.25	5402.25	5550.25	5700.25	5852.25	6006.25	6162.25	6320.25
⅝	5274.39	5420.64	5568.89	5719.14	5871.39	6025.64	6181.89	6340.14
¾	5292.56	5439.06	5587.56	5738.06	5890.56	6045.06	6201.56	6360.06
⅞	5310.77	5457.52	5606.27	5757.02	5909.77	6064.52	6221.27	6380.02

	80	81	82	83	84	85	86	87
0	6400.00	6561.00	6724.00	6889.00	7056.00	7225.00	7396.00	7569.00
⅛	6420.02	6581.27	6744.52	6909.77	7077.02	7246.27	7417.52	7590.77
¼	6440.06	6601.56	6765.06	6930.56	7098.06	7267.56	7439.06	7612.56
⅜	6460.14	6621.89	6785.64	6951.39	7119.14	7288.89	7460.64	7634.39
½	6480.25	6642.25	6806.25	6972.25	7140.25	7310.25	7482.25	7656.25
⅝	6500.39	6662.64	6826.89	6993.14	7161.39	7331.64	7503.89	7678.14
¾	6520.56	6683.06	6847.56	7014.06	7182.56	7353.06	7525.56	7700.06
⅞	6540.77	6703.52	6868.27	7035.02	7203.77	7374.52	7547.27	7722.02

	88	89	90	91	92	93	94	95
0	7744.00	7921.00	8100.00	8281.00	8464.00	8649.00	8836.00	9025.00
⅛	7766.02	7943.27	8122.52	8303.77	8487.02	8672.27	8859.52	9048.77
¼	7788.06	7965.56	8145.06	8326.56	8510.06	8695.56	8883.06	9072.56
⅜	7810.14	7987.89	8167.64	8349.39	8533.14	8718.89	8906.64	9096.39
½	7832.25	8010.25	8190.25	8372.25	8556.25	8742.25	8930.25	9120.25
⅝	7854.39	8032.64	8212.89	8395.14	8579.39	8765.64	8953.89	9144.14
¾	7876.56	8055.06	8235.56	8418.06	8602.56	8789.06	8977.56	9168.06
⅞	7898.77	8077.52	8258.27	8441.02	8625.77	8812.52	9001.27	9192.02

	96	97	98	99	100	101	102	103
0	9216.00	9409.00	9604.00	9801.00	10000.00	10201.00	10404.00	10609.00
⅛	9240.02	9433.27	9628.52	9825.77	10025.02	10226.27	10429.52	10634.77
¼	9264.06	9457.56	9653.06	9850.56	10050.06	10251.56	10455.06	10660.56
⅜	9288.14	9481.89	9677.64	9875.39	10075.14	10276.89	10480.64	10686.39
½	9312.25	9506.25	9702.25	9900.25	10100.25	10302.25	10506.25	10712.25
⅝	9336.39	9530.64	9726.89	9925.14	10125.39	10327.64	10531.89	10738.14
¾	9360.56	9555.06	9751.56	9950.06	10150.56	10353.06	10557.56	10764.06
⅞	9384.77	9579.52	9776.27	9975.02	10175.77	10378.52	10583.27	10790.02

	104	105	106	107	108	109	110	111
0	10816.00	11025.00	11236.00	11449.00	11664.00	11881.00	12100.00	12321.00
⅛	10842.02	11051.27	11262.52	11475.77	11691.02	11908.27	12127.52	12348.77
¼	10868.06	11077.56	11289.06	11502.56	11718.06	11935.56	12155.06	12376.56
⅜	10894.14	11103.89	11315.64	11529.39	11745.14	11962.89	12182.64	12404.39
½	10920.25	11130.25	11342.25	11556.25	11772.25	11990.25	12210.25	12432.25
⅝	10946.39	11156.64	11368.89	11583.14	11799.39	12017.64	12237.89	12460.14
¾	10972.56	11183.06	11395.56	11610.06	11826.56	12045.06	12265.56	12488.06
⅞	10998.77	11209.52	11422.27	11637.02	11853.77	12072.52	12293.27	12516.02

Producer Gas for Engine Fuel

Conditions to Be Met with the Various Fuels Used in Producer Gas Plants. Comparative Advantages and Disadvantages of Different Coals

BY E. A. ALLCUT

During the last few years, the application of gas power for engine work has been rapidly extending. The increase in the use of gas for the purpose of power generation has been as noticeable in the smaller units of 100 horsepower and under, as in the larger installations. This continued demand for small units is all the more striking when we consider the favorable rates at which electrical energy is available for power purposes in most of our English towns. It would seem, at first sight, a hopeless undertaking for the small power user to generate his own supply in face of such formidable competition. The success of the gas-driven plant under such adverse conditions, is due to improvements in the gas producer, rather than to the adoption of any new principles in the engine itself.

In all industrial concerns cheap power is an important desideratum. The demand of the majority of manufacturers is comparatively low, and as steam-driven units of small size are rather uneconomical, the choice usually lies between electricity or gas from the public supply, and private generation from a gas producer. The first two are usually only available at cheap rates in large towns, while the tendency is for manufacturers to remove their works to districts a few miles away where land is cheap and taxes are low. Above 500 horsepower, however, the steam engine begins to be a serious competitor to the gas engine, as, with high powers, its efficiency is greatly increased and the difference between it and the gas engine is by no means so marked as in the smaller units. The use of large producer-gas plants appears, nevertheless, to be gaining ground, though, in view of these and other considerations, more slowly than that of the smaller types. Gas engines of large size, 1000 horsepower and over, have not, up to the present, been successfully worked on producer gas. The large reciprocating weights in the standard double-acting engine, together with the tarry matter present in the gas, present great difficulties which practically preclude its use with a rich gas. These difficulties may be overcome in the future, but for the present the large gas engine has only a limited application. There is, however, a useful sphere of service open to it in connection with the blast furnaces of our iron districts. The poor gas of 70 to 100 B.t.u. per cubic foot, given off from the furnaces, can be, and is, very often used in these large engines both for producing the necessary blast for the furnaces and for providing light and power to the works and surrounding district. This, in itself, forms a huge source of economy, and will no doubt, in the future, be universally applied.

We now come to a consideration of the gas itself. Producer gas is understood, technically, to mean the gas generated by the partial combustion of carbon or carbonaceous matter, in a closed chamber called a "gas producer." In practice, the carbon is supplied in one of the numerous forms of coal, charcoal, or coke, while for certain purposes lignite or peat may be used. The quality of the fuel largely influences both the composition of the gas produced and the design of the producing plant itself. When air alone is supplied to the combustible the carbon simply burns to carbon monoxide and parts with some 5800 of its available 14,600 B.t.u. per lb., leaving the other 8800 B.t.u. bound up in a convenient form for use in the engine cylinder. We thus use up 40 per cent. of the heat lying dormant in the carbon with the object of storing up the residual 60 per cent. in a convenient form for the direct production of mechanical energy. This seems at first sight, to be a most uneconomical proceeding, but the waste of heat in other forms of transforming apparatus is so great as to justify this apparent waste. Of course, some of this sensible heat is recovered, as we shall see later on. The theoretical composition of the gas thus generated is some 35 per cent. of carbon monoxide and 65 per cent. of nitrogen, giving a calorific value of 118 B.t.u. per cubic foot. This is the theoretical composition of blast-furnace gas. The coke present in excessive quantities presents a deep bed of incandescent fuel to the air blast with the result that the furnace becomes a huge gas producer. The quality of the gas, as we have seen, is poor, but it is free from tarry matter, and when denuded of its dust forms an admirable fuel for the large double-acting engines chiefly met with in continental practice. The low explosion pressure given by this gas, provides an indicator card very similar to that of the steam engine, with a corresponding absence of shock in the moving parts and a more uniform turning effort at the crank than is obtained with engines working on richer gases. Smaller producers, working on air blast, however, tend to clinker up, owing to the high temperature, and thus give intermittent working and bad gas. To absorb some of the 40 per cent. of sensible heat given out by the carbon, steam is added to the air on its way to the producer. The reaction of steam with incandescent carbon is endothermic and results in the production of equal volumes of carbon monoxide and hydrogen. The resulting gas, called water gas, has a thermic value of about 350 B.t.u. per cubic foot. The addition of steam therefore has the double effect of reducing the temperature of the producer and enriching the gas produced, the normal calorific value of "semi-water gas," or producer gas proper, being about 160 B.t.u. per cubic foot, when bituminous coal is used as fuel. The great question, however, is, "How much steam shall we use?" The Mond plant uses about 2½ pounds of steam per pound of coal consumed, while the blast furnace uses none. It is obvious that, with excess of steam, as well as with no steam at all, the conditions are not so favorable for the production of a rich gas, as they are at some intermediate stage. The combustion of carbon, even with a small supply of air, cannot always be limited to the production of carbon monoxide. The higher oxide, CO_2, is always present in large or small quantities. The extent to which the higher oxide is formed, is solely a function of the temperature, so that the admission of steam, in controlling the temperature has a further action upon the chemical composition of the gas produced. A temperature of 1000 degrees Centigrade and over, favors the formation of the monoxide, while at lower temperatures the proportion of carbon dioxide in equilibrium with the monoxide becomes greater and greater as we approach 600 degrees Centigrade, below which the action becomes inefficient. For a rich gas and high efficiency the producer should therefore be kept as hot as is consistent with successful working and the non-formation of clinker.

The formation of carbon dioxide instead of carbon monoxide does not, however, in itself imply inefficient working, as the extra heat liberated by the complete combustion of carbon could, theoretically, be utilized for the decomposition of steam, or to raise steam for the process itself. At a low temperature, however, the bulk of the steam passes unchanged through the producer and is simply condensed in the scrubbers, so that the heat thus used would be entirely wasted. The experiments of Doctors Bone and Wheeler on a 2000-horsepower Mond plant tend to show that no economy, but rather loss, attends the introduction of excessive amounts of steam into the plant. It was found that the best results were obtained with a feed of some 0.45 pound of steam per pound of coal consumed. This was with a large plant using bituminous fuel and regenerative apparatus. With a small producer using anthracite pea coal and no regener-

ation, my own results point to a supply of 0.7 pound of steam per pound of coal consumed as the best figure. This gave a gas very similar to that usually obtained in a suction plant, and indeed, the conditions obtaining during the test were very similar to those under which suction plants work. The practice of adding 1 pound and upward of steam to the air blast is, therefore, wasteful in steam, necessitating the erection of a large and costly regenerative plant to recover the latent heat of the unchanged steam and produces a poor gas.

The fuels principally used in gas producers are anthracite and bituminous coals. The former, consisting of 90 to 95 per cent. of carbon, produces very few volatile hydrocarbons and little ash and is, therefore, an admirable fuel for this work. On the other hand, it produces a poor gas, and on account of its scarcity in England is very costly. The bituminous coals are cheap and abundant, and can thus be used in plants of the largest size. It is noteworthy that these producers are designed to use the smallest sizes of coal that were formerly useless for steam-raising purposes, and so use the very cheapest fuel available. The chief objection to the use of bituminous fuel is due to the large quantities of volatile hydrocarbons given off by the coal on heating. The presence of these impurities necessitates the use of elaborate cleaning devices to wash out all tar and dust from the gas before it enters the engine cylinder where these deposits form a prolific source of trouble. Even with the present-day washers, small quantities of tarry matter leak through the apparatus and necessitate the frequent cleaning of valves, or else preignition occurs. The initial cost and complication of this cleaning plant is sufficient to prohibit the use of bituminous coal in small installations where the cheap fuel would otherwise be very welcome. Consequently plants of small size are almost invariably worked with anthracite or coke. The latter, though cheap, contains considerable quantities of ash, which tend to fuse into clinker, so that its use is by no means so widespread as one would otherwise expect.

The design of the producer and plant depends almost entirely upon the class of fuel used. As nonbituminous fuel is free from volatile matter, the producers and cleaning plant are very simple in design, simply consisting of a firebrick-lined shell with a grate supporting a deep bed of fuel and devices for feeding in the fuel and taking out the gas. The air is forced in by a steam injector when an auxiliary boiler is provided, or, if not, by a fan. Although the plant may be slightly less efficient when the injector is installed, yet it is more self-contained, as the presence of a fan presupposes the existence of an independent prime mover, or a separate electric supply. The sensible heat of the hot gases, which leave the producer at a temperature of some 300 degrees Centigrade, are usually extracted by a boiler or regenerator surrounding the outlet pipe, or in the top of the producer. The only cleaning and cooling apparatus necessary is a coke scrubber and a sawdust drier. It is obvious that the gas must be cooled to as low a temperature as is economically possible so that the maximum weight of gas and air may be admitted to the engine cylinder. The high cost of the fuel forms a serious obstacle to the extended use of this type of plant. For some years after the introduction of gas producers, the engines used with them were quite small, and so it was quite possible to use these high-grade fuels. But of recent years the gas engine has been developed to give 1000 to 4000 horsepower in single units and the capacity of the producer has been correspondingly enlarged. When large quantities of fuel are daily being converted into combustible gas, the price of the fuel becomes an important item. The utilization of our cheaper grades of coal, and even lignite and peat, has, therefore, assumed an important phase.

There is nothing new in making gas from bituminous coal—this has been done from the first for furnace work where the hydrocarbons present are actually advantageous, as they increase the heat of combustion of the gas. For engine work, however, the tar and soot must be effectually cleaned out of the gas, and it is here that the chief difficulty lies.

The first serious attempt to attack this problem was made by Dr. Ludwig Mond, and the details of his famous plant are now well known; it is, therefore, unnecessary to describe it here.

It should be remembered, however, in connection with this part of the subject, that bituminous coal contains a fair proportion of nitrogen which, under suitable conditions, appears in the gas in the form of ammonia. On treatment with sulphuric acid, one ton of coal yields something like 70 to 90 pounds of ammonium sulphate, which can be sold for agricultural purposes at a price of about £12 per long ton. This means that if coal dust or slack at 12 shillings per ton be used and a yield of 70 pounds of ammonia obtained, the return in by-products alone is about 60 per cent. of the fuel bill.

This is an important item and it is no wonder that attempts are made to keep the conditions such as will preserve this ammonia from decomposition. What are those conditions? The temperature inside the producer must be kept below 600 degrees Centigrade, whereas in the ordinary producer it is about 1200 degrees Centigrade. This means, as we have seen before, that an excessive amount of steam has to be used to keep down the temperature, with a consequent deterioration in the quality of the gas. In fact the content of carbon dioxide in a normal Mond gas is about 16 to 18 per cent. The amount of steam used in the plant is about 2½ pounds per pound of coal, about five times as much as is needed to supply the best gas. As only about 20 per cent. of the steam is decomposed in the producer, it follows that the free steam carried away by the gas, takes away from the producer an enormous amount of latent heat, with the natural consequence that the regenerative apparatus is both costly and cumbersome. On the other hand, it has been found that the sulphate cannot be profitably recovered with plants of less than 2000 horsepower, so that for smaller sizes, it scarcely justifies its existence and should be replaced by a simpler and cheaper type of plant. The erection of towers filled with pipes for transferring the heat from water to air and *vice versa* is both costly and uneconomical. In a test of a 500-horsepower Mond plant it was found that the heat taken up by the air in the warming tower was only about 20 per cent. of that carried by the water. The gas should be split up into smaller sprays and the wetted surface presented to it very much greater than is obtainable in these towers. The dashers used, too, are very deficient in this respect and are of a very weak form. The question facing the manufacturer who wishes to install gas producers for his engines is this—whether he will use his plant as an ammonia manufactory with gas as a sort of by-product or whether he will use a reasonable amount of steam in the producer and use it to the best advantage for producing a fairly rich gas suitable for engine work. The answer to this depends largely on local circumstances and no definite rule can be laid down to cover all cases. To return to the tar, it is found that however much the washing apparatus for these types may be multiplied, tar globules have a knack of worming their way through them and ultimately finding their way to the engine cylinder. Attempts have been made to split up the hydrocarbons by passing them through a hot zone inside the producer. This may be done by inverting the combustion so that the air is introduced above the fuel and blown downward through the incandescent fuel. It was effected in another way by Whitfield, who drew off the tarry vapors from the raw fuel by means of the steam injectors and introduced them into the hottest part of the fire. Other makers have a deep charging bell which forces the vapors to take a downward sweep before leaving the top of the fire. These complications make the working of the plant more difficult and considerably add to its first cost. The results obtained, moreover, are not commensurate with the extra trouble and expense, as the tar cannot be reduced in this way by more than 30 per cent. Most experts are of opinion that the temperature of the producer is nowhere high enough to split up this tar, and that the so-called "fixing" is merely a burning to carbon dioxide with a consequent deter-

ioration in the quality of the gas. In effect, gases obtained by this method usually contain more dioxide than when the tars are unfixed. It is generally considered therefore, that the simpler method of washing or condensing out the tar is preferable to that of destroying by heat. In this connection, atmospheric coolers are both bulky and expensive, besides being inefficient, although they dispense with the use of water. For extracting the tar, I am of the opinion that by far the most efficient apparatus is a fan, rotating in the gas at a very high speed. A water spray, introduced into the middle of the rotor, is broken up into extremely fine drops which seize the globules of tar and dash them against the casing, from which they drain into the settling tank. These fans are very efficient in practice; the power required to drive them is small, and their water consumption is low. For satisfactory cleaning it is advisable to send the gas through two fans in series. Owing to the complex nature of the fuel, it is only natural to expect that these bituminous producers and plants should be more troublesome and expensive than those designed for the simpler kinds of fuel. Both the first cost and upkeep of the former type are greater than those of the non-bituminous variety and this increased expenditure forms an offset to the cheapness of the fuel. The use of gas from bituminous coal for engine work is, however, comparatively recent, and we may expect that after more experience has been gained in the working of this kind of plant the results, which are even now very creditable, will make the gas plant a still more formidable competitor to other sources of power.

Babbitting on a Surface Plate

By M. E. Dawson

In the accompanying line cut is shown a surface plate that has in its design some special features that are, to me, new and novel; not alone the surface plate, but also the manner in which several jobs are done on it.

The plate is cast iron, 4 feet long, 2 feet 6 inches wide and 7/8 inch thick, with ribs 7/8 inch wide and 3 1/8 inches deep. The face of the plate is planed as nearly true as possible without any attempt at making a high-class surface finish.

If machine shops, and pattern shops as well, were equipped with a few surface plates of the machine-finished class, mechanics in general would appreciate it and make use of them to good advantage. This is especially true regarding jobbing shops where $2.98 is bid on $50 worth of work.

After the machining is finished and before removing from the planer the surface is cross-scratched into 1-inch divisions, as shown, making 48 divisions in the length and 30 in the width. The divisions are stamped on the face with steel figures and can be numbered each way from the center, or from end to end as desired. The divisions in the sketch are not correct, but they serve to illustrate the idea.

In the center is a hub 7 inches in diameter and 6 inches deep, with a hole 5 inches in diameter. This hole is bored and finished in a boring mill, and while in the boring mill circles are described on the face with a sharp pointed cutting tool. The circles are struck from the center of the hole and tangent to the cross lines, thus making the circular divisions 1 inch apart, the same as the square ones. Secured to the under side with 1/2-inch machine screws is a U-shaped frame made from 1/2x2-inch steel that acts as a stope. This is 1 inch below the bottom of the hub to allow a cleaning-out space, which is a very important detail in the construction.

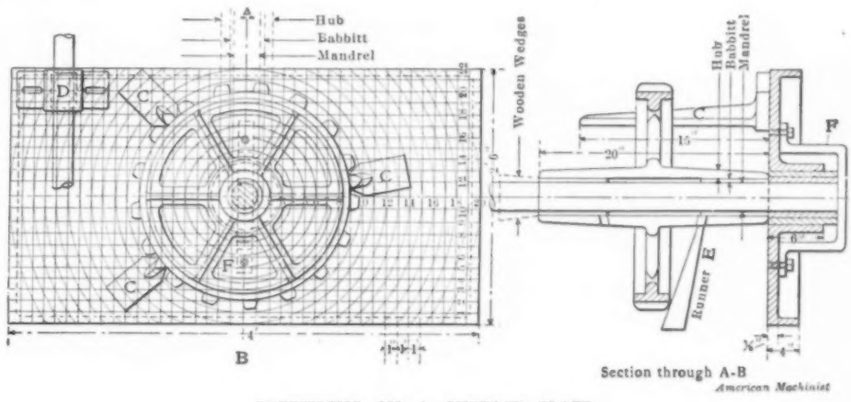
One of the many jobs done on the faceplate is shown in plan and vertical half section through *A B*. This is a cast-steel sprocket having a hub 20 inches long; 5 inches at either ends are to be babbitted, leaving a chamber 10 inches long at the center. No machine or hand work of any kind is done on the sprocket excepting the drilling of the 3/4-inch holes to receive the runner shown at *E*. This is a piece of sheet steel, gutter shaped, reduced at one end to enter the hole, the other end extending out under and beyond the rim of the sprocket where the babbitt pouring is done.

Cast-iron bushings are turned to fit in the center hole of the surface plate, and bored to receive the various babbitting mandrels; a number of these bushings will telescope, one inside of the other, as in the sketch, and rest on the stop *F*. The mandrel requires no explanation, the assembling of the mandrel and bushings in the surface plate being clearly shown in the vertical half section.

In babbitting a sheet of medium weight drawing paper, about 21 inches wide, and greased with common lubricating grease, was wrapped twice around the mandrel from the surface plate up. Around the paper was wound spiral fashion a piece of twine about 1/8 inch in diameter. This binds the paper to the mandrel making it impossible for any babbitt to run in between it and the paper, which would give much trouble when removing the mandrel from the sprocket, and the hot babbitt burns this twine away leaving oil-conducting grooves in both ends of the hub.

The sprocket is then placed over the mandrel with the hub resting on the surface plate, and secured, as near central as possible, by means of wooden wedges. Pieces *C C C* are cast-iron test gages that are placed against the sprocket. The bottom is made extra heavy and is machined at right angle with the vertical bar. The diameter of the sprocket at the bottom of the teeth is 26 inches; the test gages placed against this face will, if the sprocket is centrally correct, be at the 13-inch circle on the faceplate; any deviation from truth can be instantly corrected by shifting the bottom of the hub. After the lower end of the hub is babbitted, as shown in the vertical half section, the sprocket and mandrel are reversed and the opposite end babbitted.

Tight and loose pulleys, sprockets, shieves, also gears are babbitted on this plate. When babbitting tight pulleys only one thickness of paper is used on the mandrel. Two pieces can be done in the time required to do one by any other known method and answer the purpose for which they are intended. Journal bearings are also babbitted, and sometimes 10 are done at one setting by using the lines on a gage to set them by. It is to be understood that this class of work is not intended for the works of a watch or fine measuring instrument, but it is well to know the rough as well as the fine points in the machinist trade.



BABBITTING ON A SURFACE PLATE

According to the *Scientific American*, in some metallurgical operations steam is admitted to large vats or tanks for the purpose of agitating, and, in some cases, heating their contents. In special cases, the consumption of steam for this purpose is enormous, the reduction of which is often possible with better results by mixing air with the steam. This may be accomplished by using an ordinary injector. To insure the proper working of the device, the steam is first turned on, then the valve of the injector gradually opened until the desired amount of air is obtained.

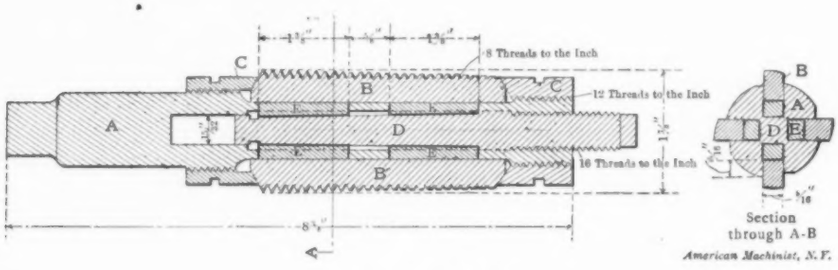
Practical Letters from Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

An Adjustable Tap

The adjustable tap shown can take its full share of hard knocks and yet retain its accuracy. Two years' experience with taps of various designs have shown this to be the strongest and most satisfactory. The body of the tap is made of Jessop's steel, hardened slightly to prevent bruises. The chasers are made of Novo steel fitted snugly to the slots milled in the body of the tap. The ends are faced to the angle shown and the cast-steel collars screwed up snugly. The tap is then turned and threaded. It will be noticed that the chaser slots are central with the tap, thus the cutting edge is in advance of the center. After threading, the chasers are removed from the tap and placed in a mandrel made exactly the same as the tap except that the slots are milled so that the cutting edges of the blades are in line with the center.



AN ADJUSTABLE TAP

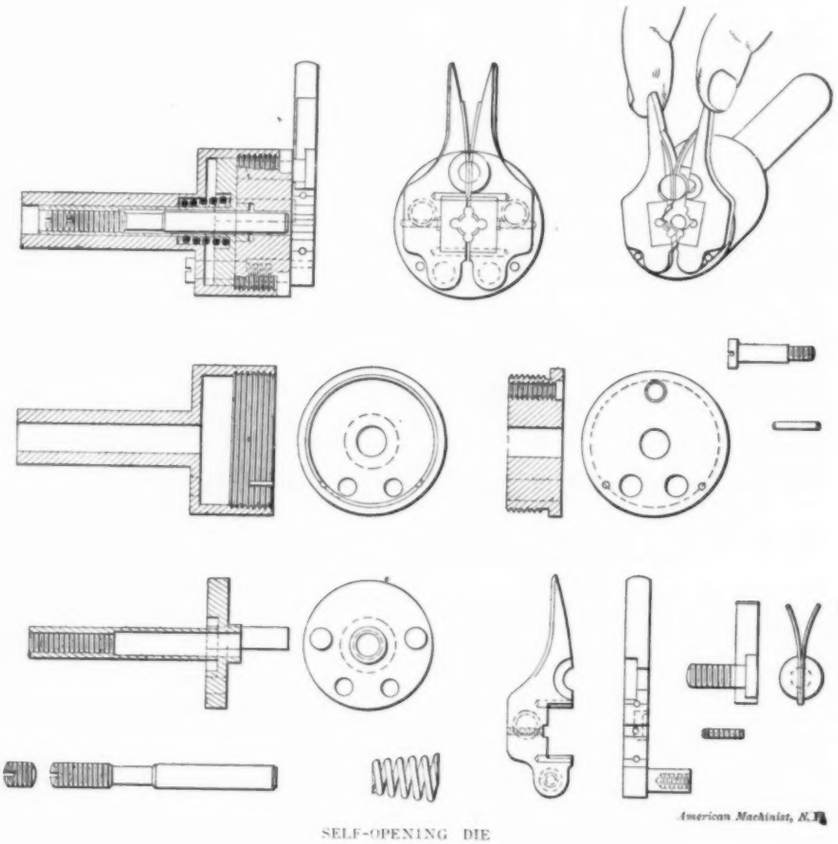
If the threading tool be run over the chasers while in this mandrel the tool will back off the chasers. Chasers thus backed off can be sharpened by grinding on the face. Left-hand chasers can be backed off by turning the mandrel end for end. *A* is the body of the tap; *B*, chasers; *C*, cast-steel collars; *D*, adjusting pin; *E*, the cast-steel plugs which rest on the adjusting pin and support the cutters.

H. E. CHITTENDEN.

Brantford, Ontario.

Self Opening Die

The accompanying drawing illustrates the construction and operation of a simple self-opening die holder which I have designed and constructed and which is being used successfully for threading screws up to 5/16 inch diameter, which is its capacity.



SELF-OPENING DIE

The jaws carrying the half sections of the die are pivoted on studs near the circumference of the holder body, and when released are spread apart by the spring between the projecting ends which are used as handles to close the die. Hardened bushings are set in the back of the jaws, and form depressions into which hardened locking pins enter.

The locking pins are attached to a plunger within the cylindrical body. The plunger has a hollow spindle extending inside the hollow shank of the holder, and is normally held against the inner face of the cap by a spring in the neck of the shank.

The plunger spindle is threaded internally for a part of its length, and forms the support and adjustment for the stop which, when pressed in by the advancing screw blank, trips the die. The stop is set by screwing it in or out until the distance from its end to the outer face of the die is equal to the desired length of thread, minus the small amount of movement necessary to release the jaws. For long threads, beyond the range of adjustment of the thread in the spindle, a shorter stop is used. The stop is retained in adjustment by the set screw which follows it.

The jaws are prevented from lifting by screws which enter their studs from

Wanted Mixtures for Brass Valve Bolts for Pumps

We have a great many pumps of different makes that require changing the valves very often owing to severe water conditions. We would like to hear from someone who is familiar with the different mixtures used in casting brass valve bolts.

Mancelena, Mich. J. P. L.

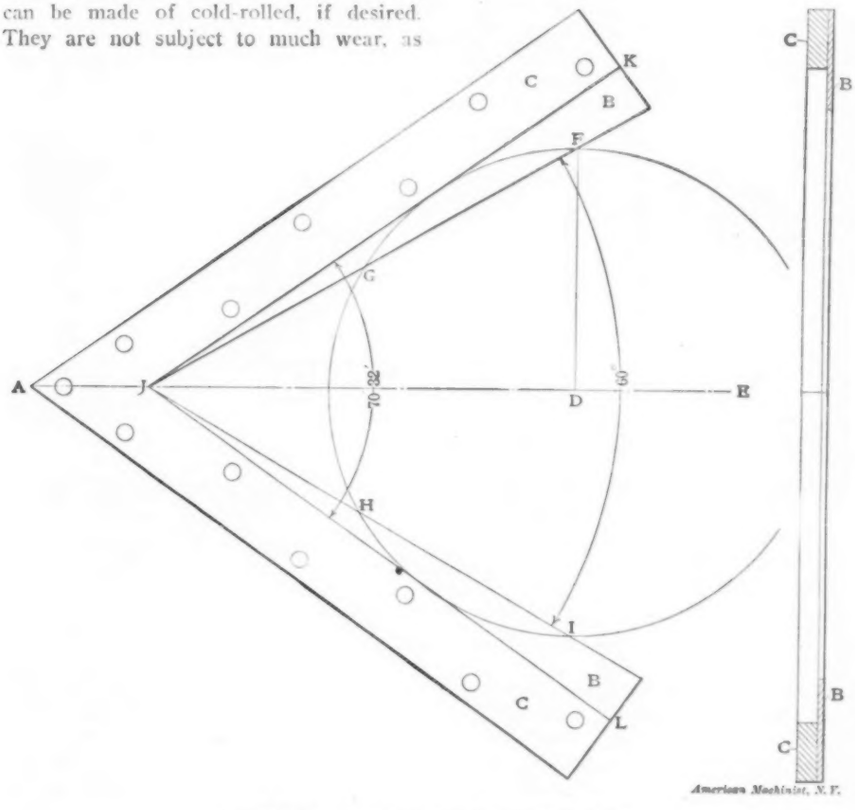
the back of the holder, and by the wide shoulder on the screw between the handles. The die is of the common square block type, in halves, and adjusted for size by means of small screws passing through the jaws.

The holder is placed in the turret with the handles in a vertical position, and chips drop down between the jaws when they open. No difficulty has been experienced with chips interfering with the operations of the device in any way. The die opens quickly and surely every time and leaves a clean thread.

Charlestown, Mass. E. ZETTERMAN.

A Hexagon Templet for Pattern-makers

The templet shown in the line cut is intended for laying out hexagons on turned blanks, for nuts, etc. It is made of sheet steel, the blades *B* being thin, say, 1/32-inch saw stock, while the blades *C*, which act as stops for the turned blanfl, ought to be not less than ⅛ inch thick. These can be made of cold-rolled, if desired. They are not subject to much wear, as



A HEXAGON TEMPLET FOR PATTERNMAKERS

they come in contact with the wood only, the scriber being used along the edges of *B*. The blades *B* and *C* are riveted together, as shown. The blades *B* are set at an angle of 60 deg., and the blades *C* at an angle of 70 degrees, 32 minutes, the same center line being common to both.

Where no protractor is handy for laying out the 70-degree, 32-minute angle it can be laid out in the following manner: At any point along the center line *A E*, of the 60-degree angle, erect a perpendicular *D F*, and with *D* as a center and a radius *D F*, strike off the circle *F G H I*. From the apex *J* of the 60-degree angle draw the lines *J K*, *J L* tangent to the circle *F G H I*, and the angle *K J L* will be the angle desired for the blades *C*. In use the tool is laid on the turned piece of wood so that it touches the two inner edges of the blades *C* the same as the circle shown in the line cut. The lines *G F* and *H I* are then scribed along the inner edges of *B*. The tool is then turned around so that the point *G* is in the position occupied by *F* in the cut and two more lines are scribed. A final indexing in the same way finishes the laying off of the hexagon. The tool is suitable for all sizes of hexagons within its capacity.

New York. J. WATT.

Boiler-Ferrule and General Bush Extractor

The line drawing herewith illustrates a useful appliance designed for the purpose

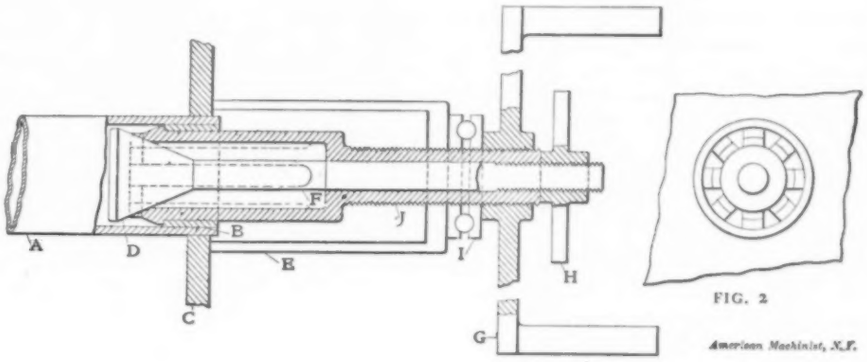


FIG. 2

FIG. 1. BOILER FERRULE AND GENERAL BUSH EXTRACTOR

of extracting ferrules from smoke tubes of locomotive, traction and portable engines. It has been designed with the object of providing a superior method of extracting ferrules to that which is in vogue in some repair shops (in which they are driven out with a hammer and long, steel drift), and also of furnishing the boiler repairer with something better in the way of a mechanical extractor than those now in use.

The tool shown will be found to be a sound contrivance, inexpensive to make, and a good tool to have around when ferrules require to be hustled out. Being furnished with a ball thrust, as shown, the operator is relieved of a considerable amount of the labor usually accruing to ferrule extracting.

I have introduced this tool into several shops, and users speak well of it. For bush drawing, where "the other side" cannot be got at by the usual means, this extractor will easily do the job.

Fig. 1 illustrates the appliance. *A* is the boiler tube (2½ inches external diameter), *B* is the ferrule which has to be extracted, while *C* represents the tube plate of either the fire-box or smoke-box end of the boiler. *D* is a mild-steel core, forged or turned in one with the shank *F*. *E* is a mild-steel or malleable-iron bridge piece, with a gap in one side, so that it may be put in position or taken off without taking off the handles *G* and *H* and the ball thrust *I*. *J* is the main thread by which the ferrule is extracted by rotating the double handle *G*.

Fig. 2 illustrates an end view of the tube *A*, ferrule *B*, and the eight spring prongs into which the end of the extractor *J* is divided. To use the appliance,

slack out both handles *G* and *H*, push the divided end of the extractor through the ferrule *B*, when the eight ends of the extractor will return to their normal position, as shown in sketch.

By screwing up the handle *H* the cone *D* will be drawn tightly into the extractor, preventing the eight "snacks" from being pressed off the edge of the ferrule. It is then only necessary to rotate the main handle *G*, screwing the threaded part on to the 12-thread screws *J*, and, let the ferrule be corroded ever so tightly, it will be easily extracted.

The extracted ferrule may be taken off the extractor by squeezing in the eight parts with the hands, when the ferrule will fall off.

London, Eng. JOSEPH T. TOWLSON.

A Riveting Job

The cuts herewith show a job done on the sensitive drill press. Looking at Fig. 1, it will be seen that the job, which is a brass tube, will not stand hammering. It has a No. 12 Birmingham wire gage brass snap-head rivet through it.

The spinning tool, Fig. 2, was made to the shape, and then a punch, Fig. 3, turned and serrated with a file. The female was made red hot and the punch driven into it, thus making the serration in the female tool.

These serrations are not sharp but rounded and smooth. The female tool was then used on the annealed rivet in the sensitive drill press, forming a sharp, clean snap head in about half the time it takes

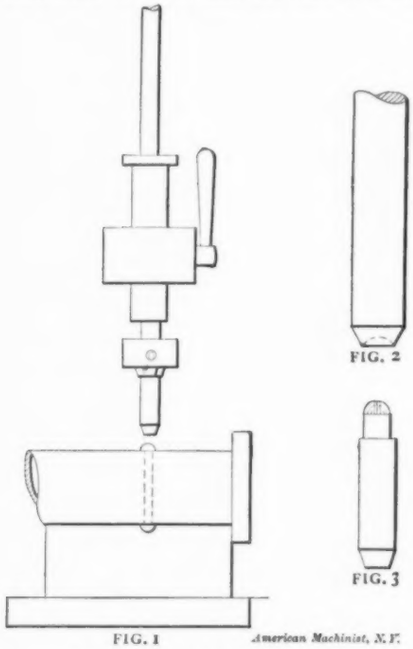


FIG. 1 FIG. 2 FIG. 3 *American Machinist, N.Y.*

THE WORK AND THE TOOLS

to rivet with the hammer, with the further advantage of not bending or denting the tube. A little tallow was used to lubricate the tool. No doubt this method is used by others on steel. Anyhow it was a real success on brass.

London, Eng. JACK JNR.

A Multiple Pantograph Engraving Machine

A rational method of making multiple engravings by means of a pantograph is shown in Figs. 1, 2 and 3. The spindles *A* are driven from a common countershaft *C*. Each one of them can be separately adjusted for depth. Figs. 4 and 5 are sections through one of the spindles showing how the rapid lifting of them from the work is accomplished by means of the lever. Fig. 4 shows us how it is possible, through the wedge surface *C* and various ratios by the block *H*. The table to which the pantograph and five pieces of work are attached can be raised or lowered as required, by means of an elevating screw under the knee of the machine.

Frankfort, Germany, F. SEIDLER.

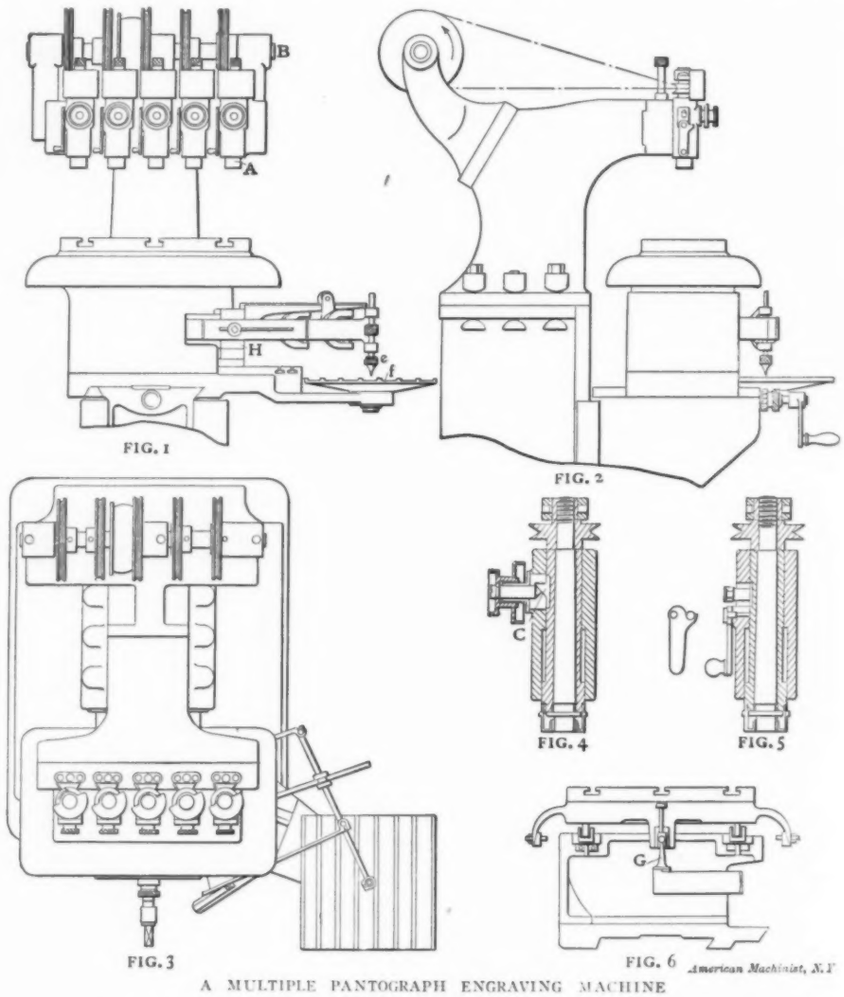


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5 FIG. 6 *American Machinist, N.Y.*

A MULTIPLE PANTOGRAPH ENGRAVING MACHINE

the screw of 1 millimeter pitch whose head is divided into 100 parts to obtain minute regulation. The thorough lubrication of the spindles is obtained by leading the oil to the lower end of the spindle from whence it is thrown to the top, through a steep helical channel in the spindle bearing, contrary to the direction in which the spindle turns at high speed. Fig. 6 shows a section through the work table which is moved by the pantograph. The guide pin *E*, Fig. 1, is guided by hand along the outline of the pattern lying on *F*, Fig. 1, and this movement is transferred by the pantograph through the bolt *G*, to the table which is mounted very sensitively on rollers. The pantograph is adjusted for va-

Protecting Firebrick Floors when Treating High Speed Steel Tools

Many tool temperers and others who treat high-speed steel tools in gas-oven furnaces are often puzzled by the rapid destruction of the furnace floors. Some floors seem to last well, while others fail and melt down in a few days. The firebrick manufacturers are generally blamed, although many experiences would indicate that the cause is outside the bricks themselves.

High-speed steel when heated to the white heat near the melting point has a marked affinity for some element in the composition of firebrick such as is used in the lining and floors of gas furnaces. For this reason little pieces of scale or steel left in the oven or furnace will burn holes in the floor and soon make it necessary to renew the bottom plates. These

plates or floors in themselves are not costly, but the renewals entail delays that are both expensive and annoying.

One way in which the plates may be made to last longer is to see that any scale which may form in the preheating or forging of tools is brushed away or scraped off before the tools are put into the high-heat oven for the hardening heat. At times one small piece of steel or the heavy scale from a few tools left overlong in the preheating oven will burn a hole so far through a 1-inch floor that it will break through on the next heat. Thus it behooves the temperer to keep the floor and tools scraped clean.

Efforts to protect the plates by means of coatings of fireclay, asbestos, borax and the like meet with little success, as these substances soften at the heat necessary for the proper hardening. When using them, if a tool be placed in the furnace the composition sticks to it on removal and interferes with the cooling, whether quenched in oil or under an air blast.

The following simple method of protecting the floors and bottom has been found very successful, and saves nearly all of the time and expense incident to the frequent changes and renewals:

Mix about equal quantities of fiber asbestos and fireclay with enough water to give a composition of mortar-like consistency. Spread a thin layer of this over the floor or bottom plate. An ⅛ to ¼ inch is sufficient. Let this dry over night and start the heat slowly the next morning. Procure some split firebrick, about 1 inch thick, and place one, two, or three in that part of the oven where tools are placed while heating. All tools hardened should be placed on these bricks so that any scale which drops off will sink into the split brick. The coating mentioned above causes the split bricks to stick to the bottom plate or floor, enough to prevent their sliding around, but at the same time they do not stick too tight to prevent easy removal while the furnace is hot.

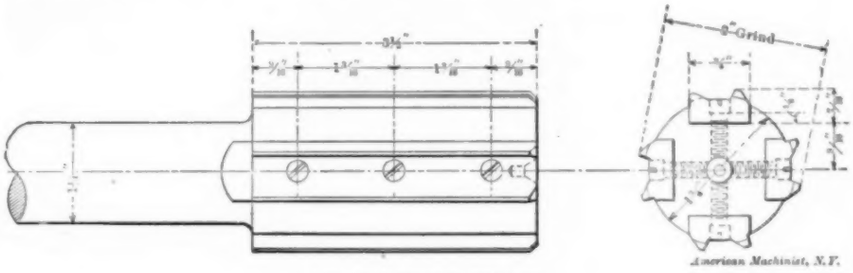
These split bricks should be taken out at the end of each day's work just before the gas is turned off. They should be examined closely and if there is the slightest sign of steel or scale burning through on the lower side of the brick, throw it away and use a new one. Sometimes they will burn through and show a black, burned spot after only a few hours' run, and at other times a brick will last for a week or 10 days under severe daily service.

The time lost in changing these split bricks amounts merely to taking one out with tongs while it is hot and placing in a new one before heating the next day. The coating of asbestos and clay need be applied but once and will last until the entire bottom is changed. The usual method of changing floors necessitates taking down a considerable part of the furnace and chipping out melted parts of the floor. "Split" firebricks are a staple article wherever furnace and foundry supplies are kept and the cost is nominal. In using this method the temperer has the satisfaction of knowing that every third split brick thrown away means a floor or bottom plate saved and with it a great saving of productive time.

Chicago, Ill. M. DOGECLA.

An Adjustable Reamer

This adjustable reamer is at present being used by one of the largest and most enterprising automobile concerns in this country. It can be used either as a hand reamer or machine reamer. It gives good results whether used in steel, cast iron, brass or aluminum.



AN ADJUSTABLE REAMER

The shank of this reamer is of tool steel while the blades are of Novo steel, tempered and held in place by fillister-head cap screws. To adjust, the blades are shimmed up with either sheet steel or paper, according to the requirements. Then each blade is screwed firmly into place. The reamer is then ground to the required size. These reamers can be made and used to an advantage for any size from 1½ inches up.

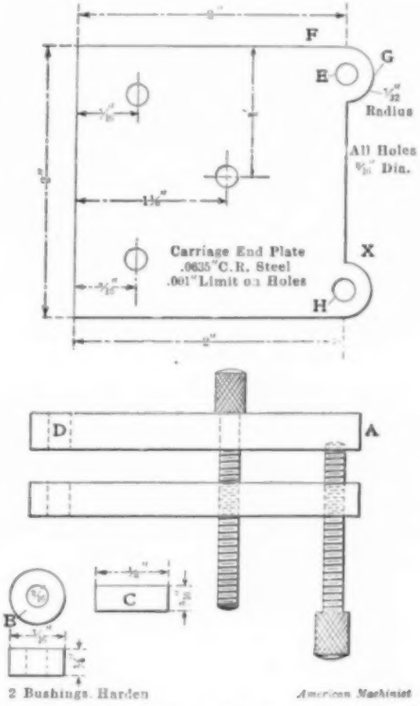
Bridgeport, Conn. J. WATSON.

Locating Holes Accurately in Model Work

To lay out a piece of model or experimental work and locate a number of holes accurately, has always been a difficult job, especially if the limit of error was less than 0.001 inch, but with the tools illustrated, the task is much simplified.

The clamp *A* differs from the ordinary clamp only by having the hole *D* through both jaws, this hole being a little larger than 3/16 inch in this case. The bushings *B* are of tool steel, hardened, and should be ground if the job is to be very accurate, while *C* is a piece of 3/16-inch Stub's steel. Given these tools and a drawing of the "carriage end plate," with instructions to make an accurate model, we will proceed in the following manner.

Take a piece of 0.0625 sheet steel



LOCATING HOLES ACCURATELY IN MODEL WORK

2¼x2½-inches and after straightening it carefully, mill the two edges *F* and *G* square. Then drill and ream the hole at *E*, allowing about 1/32 inch to be milled from edges *F* and *G* after the hole is located. Insert the piece of Stub's steel *C* in the bushing *B* and place pin *C* in hole *E*, pressing it down until the bushing comes in contact with the sheet steel, holding it securely with a small parallel clamp.

The next thing to do is to place the other bushing near where the hole *H* is required and hold it lightly with the clamp *A*, keeping the hole in the bushing in line with the hole in the clamp, this being done by inserting a small piece of 3/16-inch Stub's steel through both bushing and clamp. Now by having the clamp loose enough to allow it to move with a light tap with a piece of brass, adjust the second bushing and clamp until the distance from the outside of one bushing to the outside of the other measures 2 inches with the micrometer or vernier. Then tighten the clamp, remove the piece of Stub's steel and drill the hole *H*. This method locates the holes correctly and it takes very little time to drill any number of holes. The other three holes may be located in like manner. After all holes are drilled the

edges are then machined with proper relation to the holes and can be made very accurate without any trouble.

The radius at *G* and *H* is finished by placing the pin *C* through the hole and putting a bushing *B* on each end of the pin and filing the metal away until the diameter is reduced to the size of the bushing. A standard set of these bushings and pins, a clamp as illustrated and a standard set of counterbores form the most valuable set of tools a modelmaker can own. The bushings should be made with holes of sizes mostly used and should be of standard diameters and lengths, as follows: All bushings with holes 3/16 inch or smaller should be ¼ inch diameter and ¼ inch long. All bushings larger should have ¼-inch holes and be ¼ inch long so it will always be possible to insert one of the ¼-inch bushings in the hole of the large bushing and thus have a 1-inch bushing with 1/16-inch hole, or any other size that may be desired.

Pittsburg, Penn. A. R. LEE.

How Can This Press Beam be Strengthened?

The cast-iron cross-beam of a press constructed as shown in Fig. 1, broke first at *A A*, and the next casting had its hub cracked at *B B*.

Smith proposed to strengthen it by putting on a truss of **T**-shaped section, as

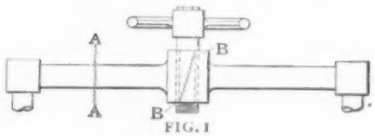


FIG. 1

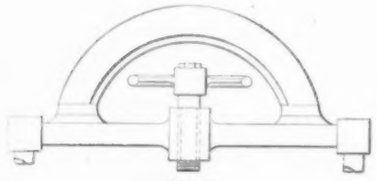


FIG. 2

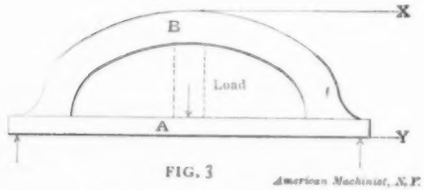


FIG. 3 American Machinist, N.Y.

DIAGRAMS OF PRESS BEAMS

shown in Fig. 2, as the depth of the hub cannot be changed.

Jones said this would not help and states his view as follows: *A* is a beam, Fig. 3, supported at ends and load in the middle. This beam *A* is reinforced by the beam *B*; this reinforcement does not make the depth of the beam the distance from *X* to *Y* unless a strut (shown in dotted lines) is placed between these two members.

Kindly let the readers of the AMERICAN MACHINIST decide on this case.

Rome, N. Y. C. L. S.

Fixture for Machining Square Holes on a Power Punch Press

Couplings with square holes through them are quite common in automobile work, and considerable thought has been given to their manufacture. I will endeavor to describe a fixture which has been successfully used for machining square holes on a punch press instead of broaching them as most manufacturers do. The couplings machined in this fixture ran absolutely true when placed on an arbor and tested in a lathe.

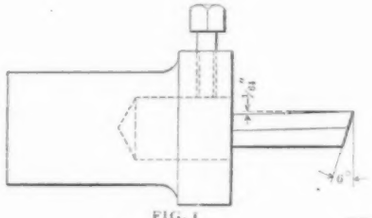


FIG. 1
Tool and Holder

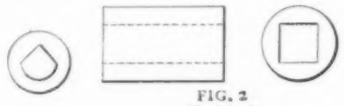


FIG. 2
The Work

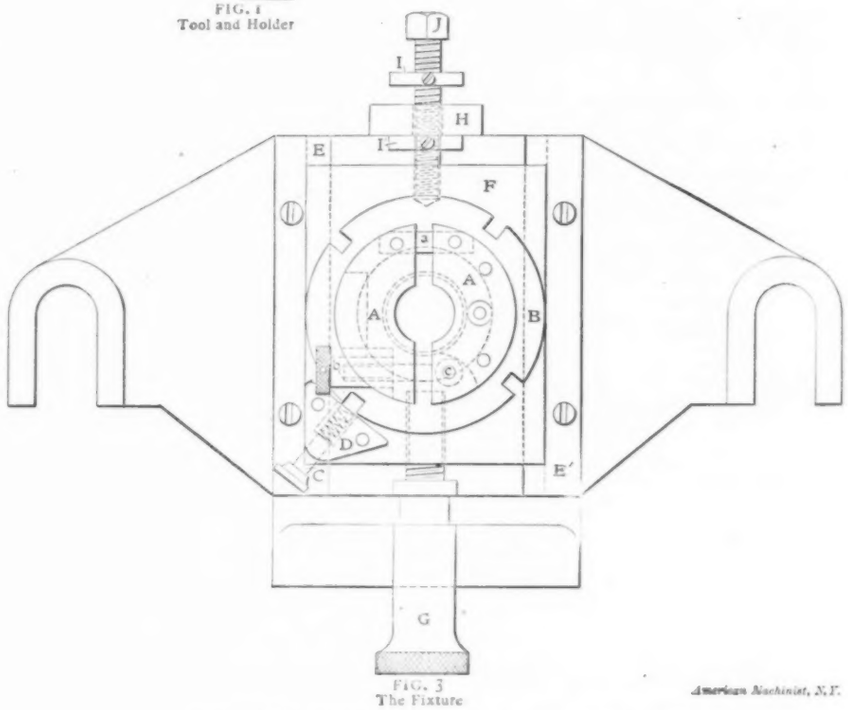


FIG. 3
The Fixture

American Machinist, N.Y.

MACHINING SQUARE HOLES ON THE PUNCH PRESS

Fig. 2 shows the work done, while Fig. 1 shows the punch for finishing the hole. The punch should be made with a clearance of 1/64 inch from the cutting edge to the depth of the punch, so that the chips will not "lead" up the punch. The shearing end of the punch should have a shearing angle of 6 degrees, the holder, of course, being made to fit the punch press. In the fixture shown in Fig. 3, *A* is a vise for holding the work, pivoting on the hinges *a* and clamped by the nut *b*, which threaded on a rod end pivoting on the pin *c*. The dividing device *B* is held in position by the pin *C*, which is supported by the spring in the piece *D*, to hold the pin in contact. The vise and dividing device are fastened on the plate *F*, which is grooved on the sides and guided by the small plates *E* and *E'*, and its movement back and forward is controlled by the screw *G*, while *H* is a stop for the travel of the plate *F*, and is controlled by the collars *I* and *I'*, which are fastened on the set screw *J*, passing through a clearance hole in *H*. The base of the fixture is made to fit the table of a power punch press. The vise in the fixture could be made to receive split bushings, so that different sizes and classes of work could be done at small expense, such as tappet guides, ends of cam shafts, or any piece which may require a square hole.

St. Louis, Mo. C. J. SCHAEFER.

The subject of electric drive in machine shops is one receiving marked attention throughout the world and for the purpose of presenting further contributions to the question, experiments on the best methods of utilizing electric drive in machine shops are being undertaken at the present time by the Engineering Experiment Station at the University of Illinois, Urbana, Ill.

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

Dies for Forming Tubes

I believe the following suggestions and sketches as requested by A. B. Card, at page 839, will entirely meet his requirements:

BLANKING TOOLS

The first operation is to get out blanks of the required thickness for the tubes and as these must be 0.02 inch thick when finished, the stock from which the blanks are cut must be the same thickness, perfectly circular in shape and as flat as possible for good results. These blanks may be cut from sheets or strips of sufficient width to give a perfect blank without nicks on the edges, as shown at *a*, Fig. 1.

To cut such blanks there will be required a set of blanking tools as shown by Fig. 1, in which *A* is the die and *B* the punch. *C* is the stock and *D* the blank which I have shown to be about 4 inches in diameter, though this may not be exact as I have not figured it out, which must be done before making expensive tools, especially if the maker does not want too much metal to go to waste, though some extra metal must be allowed to spare for finish on the ends of the tubes.

FORMING THE CUPS

Having perfect blanks, the next operation will be to form them into cups for which will be required a set of cupping tools, as shown by Fig. 2, though not necessarily of the dimensions given, as this will depend entirely on the ductility of the metal to be worked. If it is very soft the tools may be of smaller diameter than 2½ inches, as I have shown, and if it is rather hard they must be larger. The tools, I believe, will almost explain themselves from the sketch, in which *A* is the punch, *B* the die through which the blank is forced and formed into a cup, *a*, *b* and *c*. *D* is a clamping piece to hold the die down as it will have a tendency to pull out of the die bed *C* when the punch has forced the cup through the die and starts on the return or "up stroke," for then the top of the cup will strike against the bottom edge of the hole in the die which must be left with a sharp corner so the cup will not stay on the punch and be pulled up through the die again instead of stripping off and falling into a receptacle below, which it should do.

The outside diameter of the punch must be the inside diameter of the die minus two thicknesses of the stock to be drawn. Care must be taken to have the punch and die of proper relation to one another as regards diameter, in accordance with the thickness of stock used, for if the clearance between the punch and die is less than the thickness of the stock by, say, 10 or 15 per cent., the result will be a cup reduced in thickness around the side which will look something like the enlarged section *E*, Fig. 2, which, as will be noted, has a "corner" at *X*, which corner will come up higher on the side of the cup after the next draw and will form a lap all around, as shown greatly exaggerated at *X'* on enlarged section *Y*. The depression dimensioned 4 inches, shown on top of the die, should be a little larger than the blank, so that it will drop in freely without pinching. This depression serves to locate the blank in the proper position so that the punch will strike as near the center as possible; otherwise the result will be a cup something like that shown at *b*, Fig. 2, which

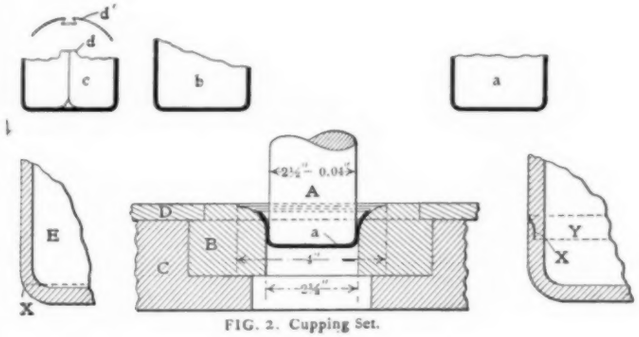


FIG. 2. Cupping Set.

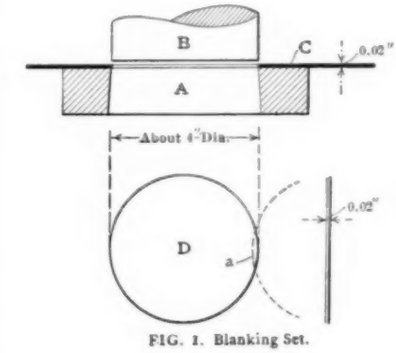


FIG. 1. Blanking Set.

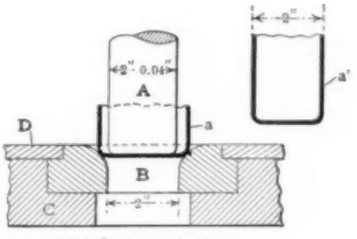


FIG. 3. Redrawing Set.

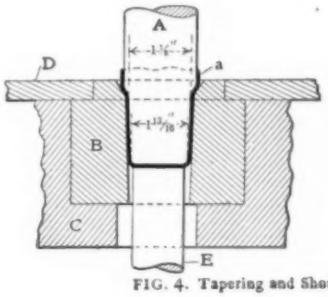
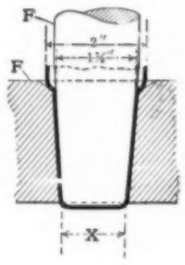


FIG. 4. Tapering and Shouldering Sets.



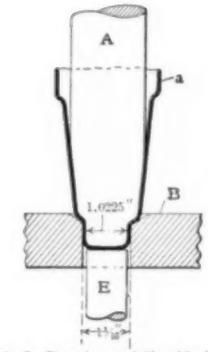


FIG. 5. Drawing and Shouldering Small End.

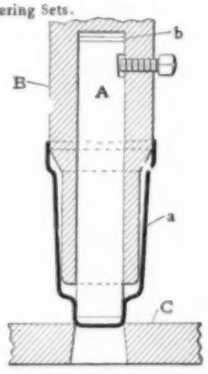


FIG. 6. Bottom Punching.

American Machinist

DIES FOR FORMING TUBES

is worthless, unless plenty of extra stock has been allowed in the diameter of the blanks.

On the other hand if the blank has been figured close then such a cup will result in a tube too short on one side. If a nicked blank, as shown at *a*, Fig. 1, is used, the result will be a cup with a crease on one side, as shown by *d d*', Fig. 2, caused by the metal buckling at the nick when the punch strikes the blank and it begins to draw.

Redrawing Dies

Having now formed the blanks into cups, it will next be required to redraw them through dies such as shown by Fig. 3, which are the same as in Fig. 2, except that a depression is not needed to locate the cup as the rounded throat of the die will serve the purpose. Other sets of redrawing dies may also be required between those shown in Figs. 2 and 3, if the metal is hard or lacks ductility, but for naturally soft metals as brass or copper I am sure the sets shown will be all that are necessary to get a cup of the proper depth and diameter of two inches, which is required before proceeding with the next operation, tools for which I have shown in Fig. 4.

It will not be out of place here to state that it may be found necessary to anneal the tubes or cups before proceeding with the next operation; in fact, they have to be annealed two or three times before the tubes are finished, this depending on the quality of the metal and the amount of drawing required to finish the tubes. Drawing a tube is not different from drawing wire; it gets harder and harder at every draw, and if a tube is too hard it cannot be drawn at all as the punch will break through the bottom of the cup before it gets fairly started through the die, thereby ruining the piece each time, and this becomes more or less expensive, according to the amount of labor already performed on tubes thus spoiled.

Tapering and Shouldering Operation

In the next operation, Fig. 4, we have a punch and die the same as before except that in this case the tube cannot go through the die, as this must be so shaped as to form the shoulder near the large end of the tube. Also as the tube must come out of the die the way it went in, the die is tapered slightly as shown by dimensions.

This operation must be performed in a press having an "under motion" or "knock-out" arrangement, to which the knock-out rod *E*, Fig. 4, may be attached to force the tubes back out of the die when the punch is withdrawn on the upstroke. If the metal is very ductile the tube may be given the proper taper required when finished at this draw, instead of just a slight taper as shown, thereby eliminating the next operation and set of tools, as shown at *F* and *F*', Fig. 4, which will, however, be required unless the metal is very soft and flows quite freely.

Having given the proper taper for a finished tube we proceed to form the shoulder near the small end, for which will be required tools such as are shown at Fig. 5, these being much the same as those in Fig. 4, with knock-out rod *E*, etc. This operation will finish the drawing.

Opening the Small End of the Tube

There now remains only to punch out the bottom with a set of tools, such as is shown in Fig. 6, in which *C* is the die, *A* the punch, and *B* the punch rocket or holder, which serves also by its form to locate the punch in the tube so it will not strike on the shoulder, but go straight down through to the bottom. Metal packing is used, as shown at *b* to allow for lengthening the punch when rendered too short by grinding.

Now the tubes are finished except squaring off the ends to the proper length which can be done by holding them in a spindle with a special collet of the proper form and bringing a cutting tool endwise against them and shaving off the extra metal.

Numerous Applications of Methods

The foregoing general methods of blanking, cupping, drawing and forming will apply equally well to an innumerable variety of shaper and combinations thereof if studied carefully. They have, to my knowledge, been applied to pieces requiring 20 to 30 operations to finish with perfect success.

An ordinary good operator with the proper equipment can turn out such light work as the above at the rate of 10,000 gross per working day of 10 hours for each operation.

Worcester, Mass. P. P. Monfils.

That Deep Boring Job

To the question M. J. W. asks, on page 838, regarding the boring of a certain shaft I would suggest the following method of procedure: Center and turn the shaft to finished size and length, unless the accuracy must be such that would make this risky; in which event I would rough turn to ⅛ inch of finished size, turning a smooth portion of, say, 2 ft., at each end and near the middle for the steady rests. After placing it in suitable steady rests and fastening to the faceplate for driving and receiving the thrust, I would bore a hole, say 3¾ inches diameter, into the end of the shaft with a single-pointed tool. This hole must be deep enough to receive the full length of the boring bit and a packing flange. This flange I would make to fit the outside of the shaft (see Fig. 1).

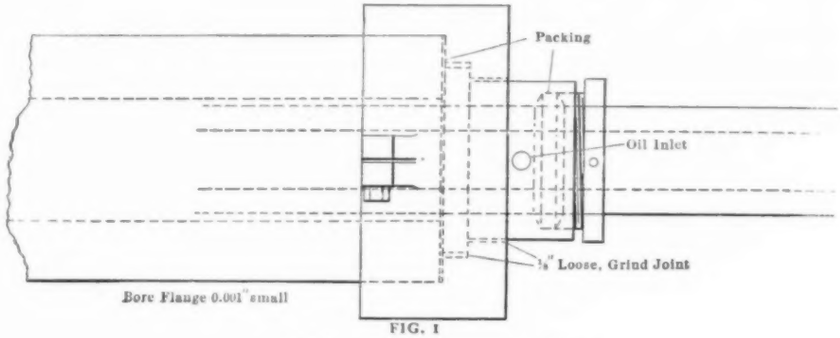


FIG. 1

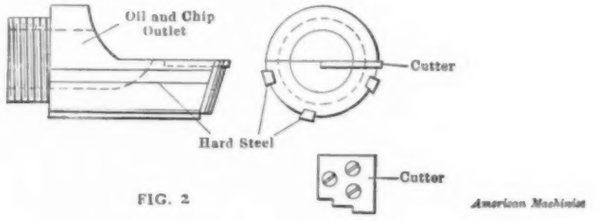


FIG. 2

DEEP BORING JOB

The flange must be oil-tight at high pressure, say 50 pounds, which pressure must be available if the chips clog.

The tools I would make as follows: Get a piece of extra heavy steel pipe that would finish to, say 3½ inches outside diameter; turn and polish this pipe and thread one end to receive the boring tools, using as coarse a thread as possible to facilitate loosening the tools.

The body of the boring tool, Fig. 2, I would make of machine steel inserting a high-speed cutter and hardened strips, which tools and strips I would grind to a true cylinder after hardening and inserting in the body, using different strips and tools for the various diameters.

I would now insert the 3¾-inch boring tool and run it to the bottom of the hole; insert the 3 15/16-inch cutter and strips and run to the bottom; then insert the 4-inch cutter and run to the proper depth. The bar I would feed with the carriage

of the lathe, and also have the bar extend through the tailstock. The dead eye which I would use on the carriage I would previously bore with a bar between centers after fastening it on the carriage. Repeat the same operation on the other end of the shaft. Finish turn the shaft by running it on false or inserted centers.

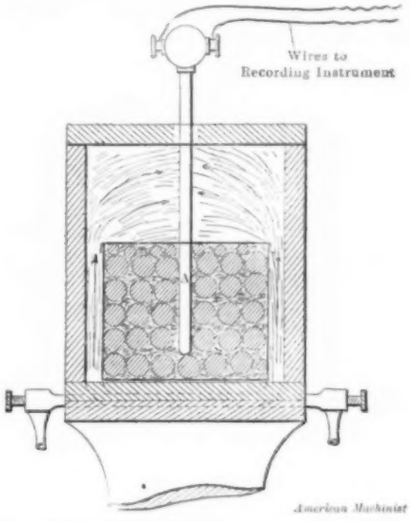
To caliper the bottom of the hole accurately I would use a tapered plug with a pipe screwed into it for a handle, then measure the plug at point of contact with a micrometer. Other suggestions no doubt will appear, from which one can select the best for the case. The chips and oil run out through the pipe.

Scottdale, Penn. M. B. STAUFFER.

How Hot Fairly Hot Is

In answer to J. Haithwaite, on page 672, as to how hot is fairly hot, this depends on the skill and eyesight of the man who is annealing, also whether the rays of the sun are shining direct on or into his furnace.

A pyrometer is a very good instrument where the end of the tube can be inserted in molten metals, or fusible salts, but it is very misleading when the end is placed in a carbonizing box with metal in the manner shown in the sketch at *A*. It will be observed that the gas flame could melt the tube surrounding the platinum or other wire that is used for registering the heat, and the color, if placed in a dark place, is red. If no pyrometer is available to tell about the right heat, have a test or telltale piece placed in the box, with the end through a hole, so that it can be drawn out to ascertain the heat in the center. After sufficient time has elapsed, draw the test piece and insert it in some common mineral grease; if it is red hot it will at once cause a flame; if only black hot it will only smoke.



PYROMETER END INSERTED IN HOT METAL

I have read in the AMERICAN MACHINIST of tools being quenched in brine; well, how salty is salt water? The definition I had given me was add salt to the water until a potato floats on the top. But wait! Is the potato to be a new or an old one? Well, that depends on the time of the year. A new potato contains more moisture than an old one, therefore the test is useless.

Now, how much salt per gallon ought to be added to the water for hardening pure carbon steel? Why is it necessary to add salt at all? Good steel ought to harden thoroughly in ordinary water with the chill off. Can any reader tell me why sea water is better than any other kind of salted water?

Davenport, Eng. A. F. SUTTON.

How to Bore a Deep Hole

On page 838 information was requested how to do deep boring, the kind of cutters and boring bar to use, and also a way in which the size of the bore at the bottom could be gotten, so that a bushing could be made a tight fit. I have had experience on this class of work and think I can give M. J. W. some help.

The line cut shows a shaft 21 feet 3¼ inches over all with a hole bored in either end; the large hole to finish 4 inches and the smaller hole at the bottom 3 15/16 inches. As I do not know what this job is to be used for, it is hard to make suggestions, but I would bore the large size hole, which is 4 inches, the full length of the two sizes, and then turn a bushing to a neat fit of the 4-inch bore, and drive the bushing to the bottom of the bore and then the bushing can act as a shoulder and a bushing.

But if it is necessary to have the job bored, as shown in the line cut, the job can be successfully done as follows: One end of the shaft placed in the lathe chuck, the other end in a steady rest. The shaft should also be supported at the center to keep from swagging. A boring bar *C*, shown in Fig. 1, is 3 inches in diameter, and has a keyway cut in one end so that a hog bit, Fig. 2, is keyed on the bar, the bit being turned to about 3.85 inches diameter.

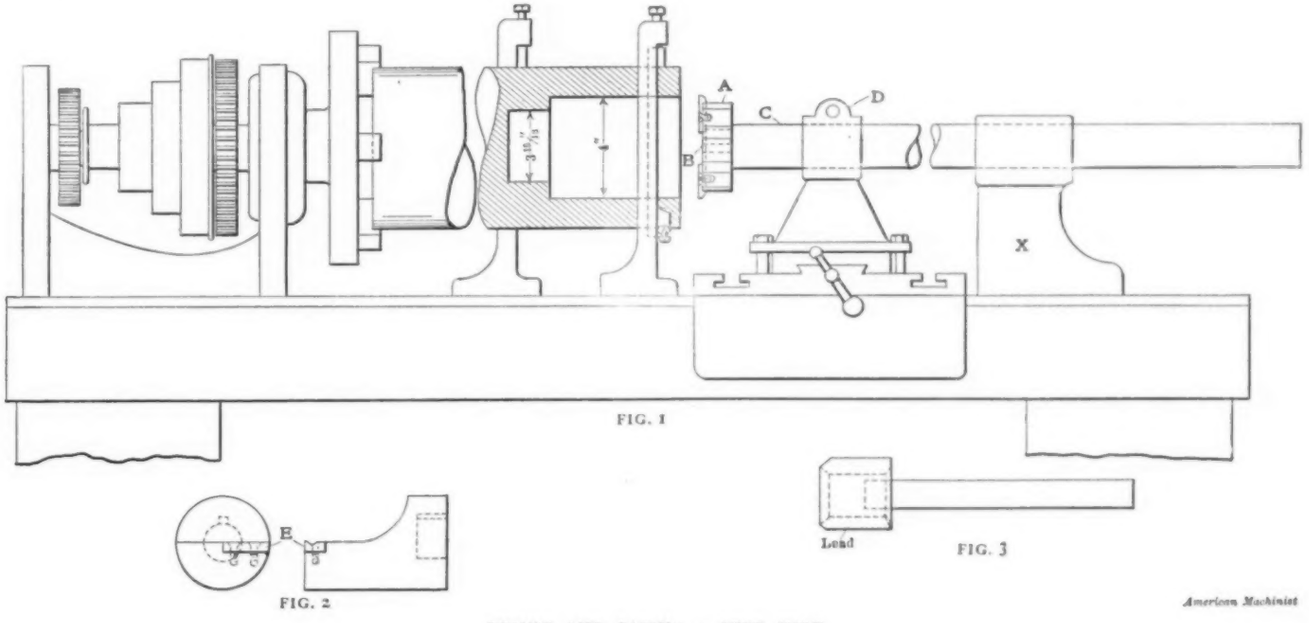


FIG. 1

FIG. 2

FIG. 3

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BORING AND GAGING A DEEP HOLE

The end of the shaft is then tooled out to the size of the hog bit and about 6 or 8 inches deep; the bit is then placed on the boring bar *C*, which is held in the lathe, as shown in Fig. 1.

The split sleeve *D* is fastened to the lathe carriage, supporting one end of the bar *C*. The sleeve *D* is clamped to the bar when boring, as the feeding is done by the lathe carriage. The bar is also supported by the bracket *X*.

In starting the cut, it is necessary to clamp the sleeve *D*, close to the boring bit, but when the tool has entered the shaft 12 or 15 inches the sleeve *D* is then moved out 3 or 4 feet and again clamped to the bar, and so on until the hole is the required depth. The hog bit, Fig. 2, is made of cast iron and about 8 inches long, and is milled off as far as the center, as shown. A cutter *E* is made of tool steel, and is placed in front of the bit, as shown, and held in position by two screws; the cutter is to be in length just half the diameter of the bore, which is to be the rough size.

This tool will do good work. I use it for boring tubing for different size guns from 10 to 43 feet long, and have no trouble. After the shaft is rough bored by the hog bit it is then ready for finish boring. A pack bit is then used, as shown in position. The bit is to be the size of the small hole at the bottom of the bore. The pack bit is built up with wood blocks. There are six dovetail slots cut across its periphery. These slots are for holding these hardwood blocks which fit closely into the bore, guiding the bar. A double-ended boring tool is clamped in the grooves across the head, as shown at *B*. Using a pack bit in this way, the job will be straight and true and the diameter of the bore will not vary 0.002 inch in the entire length. After the 3 15/16-inch hole has been finished the pack bit is then fitted up for the 4-inch size with new wood blocks and the cutters moved out for the 4-inch size. After the boring at both ends has been done, the outside diameter of the shaft can be turned off by placing the shaft on expansion or pipe centers.

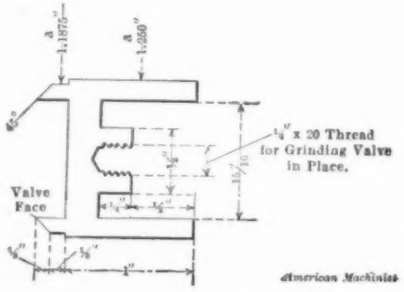
A practical kink is shown here in Fig. 3 for obtaining the size of the bottom of a deep hole. A piece of machine steel is turned up in the shape of a spool with a 1-inch hole in the center. Lead is then melted and poured around this spool-shaped plug and then turned off to slide in the large bore, which is 4 inches. A 1-inch rod is then placed in the hole of the tool acting as a handle, the lead tool is then pushed in the bore until it strikes the smaller diameter, and the tool is then rotated and at the same time forced in the small diameter. It is then taken out and the impression of the small hole is made around the lead. This can be measured and the bushing can be made a tight fit in this way.

Washington, D. C. H. D. CHAPMAN.

Dimensioning Detail Drawings

I was interested in H. Pearman's article on this subject on page 748.

Draftsmen, through no fault of their own, as a general rule do not possess sufficient knowledge of machine-shop practice to facilitate rapid production, and on the other hand many men in the shop do not possess good judgment or are often timid about exercising what they have where a lack of information exists.



SAMPLE DIMENSIONED DRAWING

Should you leave it to a man in the shop to use his own judgment in making a *small* hole, it will no doubt range anywhere from 1/64 to ¼ inch according to his sense of smallness. This calls for a system of tolerances, and where an allowance can be made it should be as liberal as possible.

When a drawing of a part is issued to the shop the foreman should have a thorough knowledge of what is required, the necessary accuracy, etc., so that the same information may be passed along to the one who does the work. Should any question arise with reference to the drawing it should be his place to find out full details.

I like to see drawings fully dimensioned and where possible such little notes as are necessary. The most accurate are given in decimals, while those where an allowance can be made, are in vulgar fractions. Referring to the accompanying sketch, one can tell almost at a glance where extreme accuracy is required and where not, while very little explanation is necessary, and the operator has sufficient knowledge to perform the work rapidly and easily.

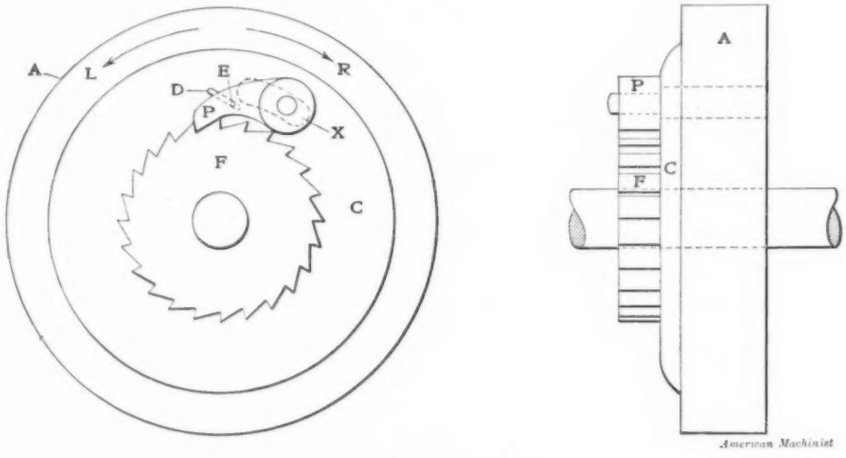
The little *a* over the dimension denotes accuracy or 1.1875 accurate. A system of finishes are employed, in this case No. 3. Finish No. 1 allows a variation of 0.0005 inch, No. 2 a tolerance of 0.002 inch, while in No. 3 the limit is 0.005 inch. This system can be modified to suit existing conditions in the shop.

G. S. SLINGERLAND.

Newport, R. I.

A Simple and Effective Type of Silent Pawl

Ralph W. Davis' description of silent pawls, at pages 890 and 891, shows some good schemes, but as this is the age of simplicity, I believe the accompanying sketch may be of interest. As in Mr. Davis' illustration, *A* represents the driving member. The friction washer *C* is held between disks *A* and ratchet *F*, and is provided with slots *D* and *X*. We will consider the arrangement moving in the direction of arrow *L*. The pin *E* engages in slot *D*, and as *A* moves forward, it carries friction washer *C* with it, the slot *D* being cut at the proper angle to bring pawl *P* into action. When *A* is reversed in the direction of *R* the operation is likewise reversed; friction washer *C* moves with *A* and the slot engages with pin *E*, lifting pawl *P* clear of the ratchet teeth.



ANOTHER SILENT PAWL

Ingram, Penn. K. P. ROLSTON.

In an Italian arsenal, the "Laboratoria di Proeisione," in Rome, which employs about 150 men, and where artillery is manufactured, the shops have metal overhead framing for all pulleys and belting, and the drive is electrical throughout.

A Novel Shop Department in a Trade School

Mechanical Skill Is Fundamental in Industrial Education—This and a Broad Experience Can Be Obtained in Restoring Second-hand Machines

BY MILTON P. HIGGINS*

It is now generally conceded by educators and manufacturers both, that industrial education means trade education, and, if the public schools are to sustain the industries, the spirit of the shop must be recognized as coördinate with the devotion to books. It seems necessary that industrial skill should be taught in school shops rather than in recitation rooms, and the possibility is recognized that both practical skill and corresponding mental discipline can be secured in a trade school if properly arranged and conducted.

The trade school will take the 14-year old boy from the ninth grade, or below. He will enter the trade school to complete the high-school period by gaining a working knowledge of a trade. Some of the preparatory work can be given the boy in the public school through the various grades, by manual training greatly improved and vitalized. By the time a boy is 18 or 20 years of age, under the right conditions, a trade and an education can be mastered, with no less mental discipline and general culture than the high-school graduate attains. This is a far-reaching claim and well worth while.

What Shall the Trade-school Shop Produce?

The real trade school must be productive, in order to be practical, so that the graduate can go directly into skilled work and will not find he is obliged to unlearn what he has been taught in school. If the trade-school shop is to be productive, a very important question is: "What shall the trade-school shop producer?"

There are several lines of products that are suitable for boys learning the machine trades in school shops, where skilled machinists with mental training is the aim of the school. Various classes of work must be chosen in order to secure to the boy training in high-class workmanship, a correct value of time, and as much breadth of shop experience as the length of the course will permit.

The object of this article is the recommendation of a novel department, which it is believed will prove suitable for teaching high-grade skill and shop experience in the most effective way.

The Restoration Department

Such a feature in a trade school may be called, "The Restoration Department," which means simply a highly organized *repair shop* for the restoration of disabled machinery. For this department there would be required a large room, well lighted and comfortable. Distributed throughout the room would be a variety of machine tools in all degrees of distress from previous service; also second-hand machines in other lines, such as engines, pumps, etc.; each machine more or less disabled and out of service for various causes, such as breakage by railroad accident, slight warping of some parts by fire, or injured by abusive or hard service, or with worn, bent or broken members. Some of these machines would be rusty and covered with grease and gum, but they will be arranged in good order and there must be ample floor space between the patients in this machinery hospital. In these spaces conveniently located there should be suitable benches and tables with clean, smooth, wood tops, whereon the machine parts can be arranged for examination.

Among these tables, conveniently located, are steam-heated cleansing kettles containing boiling soda water for thoroughly cleansing all greasy parts and bringing them to that surprising brightness that is always a delight to a boy overhauling a machine.

These disabled machines should be from first-class makers. A milling machine from a representative machine-tool builder or a wood planer from a firm with an established reputation, however old and dilapidated, are more desirable here than newer machines from cheaper makers; because one vital branch of instruction in this department is to be the study of good design, excellent construction and good wearing qualities as shown in the past service of the machine which is being dissected.

In charge of this room, furnished as above described, there would be a master or instructor, who is a practical, experienced mechanic. Surrounding him would be a group of 10 or 15 boys who have had one and one-half or two years' shop training in this half-time trade school. They will begin the dismantling of a machine, each boy doing the work assigned him as he is directed.

Each part of the machine, after thorough cleansing in the soda kettle, will be placed in order on the high table, each piece bearing a tag, on which will be written all desirable information relating to the piece. The whole class will then surround the table and the master mechanic will explain every feature of the machine; for instance, the master will call attention to the cause of any failure in the veteran machine—if a bearing was too short, or the supply of lubricant too poorly provided for, the fact will be made clear. If a part was too small, or of improper material, so that bending or breaking has resulted, each one will see it and feel the truth of the mistake.

Each pupil will be provided with measuring tools, including micrometer, calipers, etc., and the amount of wear or any other defect will help determine just what is to be done to restore the part in the best way; whether a journal is to be reground and the bearing rebabbitted or rebushed, or whether a broken part can be mended by welding or otherwise; or whether a new part is to be made from a new drawing, new pattern and new casting—whatever the conclusion is after the measuring and other observations in the diagnosis have been clearly discovered and understood by every pupil—the exact specifications will be dictated by the master and recorded on the tag by the pupil. With these specification tags attached to every part, the work of repairing will be assigned to the several boys who will go to the shop departments to perform the work under competent advice and oversight, but who will still feel a large degree of personal responsibility.

The repairs will all be completed by the pupils who are already familiar with the shop tools and methods in the trade-school departments, including drawing room, pattern shop, foundry, forge, tempering and machine shop. After the parts are ready, including scouring off old paint, sandpapering, filling and painting the cast-iron surfaces, the reassembling will be done by the same pupils under the helpful direction of the master.

Then the reconstructed machine will be belted up and tested by all the exact means employed by modern machine-tool makers before a machine is passed by the inspector, and the exact result will be recorded upon a sale tag attached with the price of the machine which is now ready to be sold. This sale tag will show all the repairs which have been made, the exact extent of defects, etc. In this way a buyer of a second-hand or a reconstructed machine will have full knowledge of what he is buying.

This will be a new feature in second-hand machine dealing, and a reputation for fair, open dealing will soon be established by the trade school, a feature of

NOTE—The idea of a repair shop for training apprentices was suggested several years ago, by the well-known Stephen W. Baldwin, of the Pennsylvania Steel Company.

*President, Worcester School of Trades.

great importance in the future of this type of industrial training. The restoration of used and disabled machinery is not at present an organized business anywhere; therefore, the question of competition will not be encountered. This is a matter for consideration in a public trade school.

The establishment of repair shops on a scientific basis would be welcomed by second-hand machine dealers and the machine users generally, and would be highly appreciated by the manufacturing public. The builder of machinery or the user of it has never been well prepared to do it to advantage. Such a department as this in a trade school has the following advantages:

Advantages of Such a Department

First, the requirement for high-grade workmanship is just as great in good repair work as it is in making new work.

Second, the large variety of grades of work fitted to all classes of mechanical ability makes repair work especially adapted to learners of all capacities.

Third, repair work can be made more interesting to boys because the variety is so great, and the results of their work can be seen sooner and better in the second-hand machine than in building machines.

Fourth, the general experience with a large variety of machines, and with all parts of each machine, is far greater and broader than is obtained in working on duplicate parts of new machinery.

Fifth, this practice will give unlimited opportunity to study with an experienced master *used* machinery after it has had years of actual service, and learn the requirements of a large variety of machinery such as extent of bearing surfaces, provision for lubrication, the practical requirement for accuracy, alinement, etc.

It might be thought that there would be some objection to training young mechanics upon old machinery because they should be in touch only with the latest and best. We must remember that the trade-school shops where the repair work is done upon the old machinery would be modern and uptodate in all respects. I claim that there may be an advantage, rather than a disadvantage, in comparing the new with the old, and after all, the second-hand machines would not be so old as to have lost their usefulness upon certain classes of work.

Machines to Be Restored

The following list of used machines which would constitute a desirable variety for the experiment have not been so radically altered within the past few years that they have become obsolete. Probably the age of the used machines would not average over six or eight years.

This list of second-hand machines, all from first-class makers, would make a desirable variety: 2 steam engines, 2 typewriters, 1 milling machine, 2 boring mills, 1 wood planer, 2 speed lathes, 2 engine lathes, 2 automobiles, 1 metal planer, 2 sewing machines, 1 profiling machine, 2 gas engines, 2 steam pumps, 1 triplex plunger pump.

Besides the broad field for skill and shop experience offered in such work as this, boys who are preparing to be our future mechanics and manufacturers would find intense interest, not only in following backward the best thoughts of inventors of past years, but in comparing them with the improvements made by present-day manufacturers. The spirit of improvement thus developed would naturally lead to an appreciation of the high skill and efficiency which will be demanded of the mechanics of the future.

Denatured Alcohol as Compared to Gasolene

The United States Geological Survey has lately issued a bulletin on "Commercial Deductions from Comparisons of Gasolene and Alcohol Tests on Internal-Combustion Engines," by Robert M. Strong. The tests were under the direction of R. H. Fernald, and were made to determine the relative economy and efficiency of gasolene as compared with denatured alcohol. It was at first found that in the same engine it took from one and one-half to two times as much alcohol as gasolene to produce a given power, but by using alcohol in an engine with a compression of about 180 pounds per square inch (which is impossible for gasolene on account of pre-ignition from the high compression temperatures), the fuel consumption in gallons per horsepower-hour can be reduced to practically the same as that of gasolene in a gasolene engine of the same size and speed.

The low heating value of completely denatured alcohol will average 10,500 British thermal units per pound, or 71,600 British thermal units per gallon.

The low-heating value of 0.71 to 0.73 specific gravity gasolene will average 19,200 British thermal units per pound, or 115,800 British thermal units per gallon.

A pound of gasolene requires approximately twice the weight of air for complete combustion as a pound of alcohol.

A gasolene engine having a compression pressure of 70 pounds but otherwise as well suited to either fuel, will, when using alcohol, have an available horsepower about ten per cent. greater than when using gasolene.

An alcohol engine having a compression pressure of 180 pounds will give a maximum horsepower about 30 per cent. greater than that of a gasolene engine having a compression pressure of 70 pounds, but of the same dimensions.

Alcohol diluted with water in any proportion, from denatured alcohol, which contains about ten per cent. of water, to mixtures of about equal parts of water and denatured alcohol, can be used in engines if they are properly arranged.

When used in an engine having a constant degree of compression, the amount of pure alcohol required for any given load increases and the maximum available horsepower of the engine decreases, as the dilution increases. The rates of increase and decrease respectively are such, however, that the use of 80 per cent. alcohol instead of 90 per cent., or denatured alcohol, has but little effect upon the performance of the engine; so that if 80 per cent. alcohol can be had for 15 per cent. less cost than 90 per cent. alcohol and could be sold without tax when denatured, it would be more economical to use the 80 per cent. alcohol.

The relative fire hazard involved in the storage and handling of gasolene and denatured alcohol is of particular importance in considering their use as fuels. Considerable work has been done on this phase of the investigation and a series of tests to determine the relative hazard is in progress at the testing station in Pittsburg.

In regard to absence of smoke and disagreeable odors, alcohol has many advantages over gasolene or kerosene as a fuel. The exhaust from an alcohol engine is never clouded with a black or grayish smoke from incomplete combustion and seldom, if ever, with a bluish smoke when a cylinder oil of too low a fire test is used or an excessive amount supplied, as is so often the case with a gasolene engine. The odors of denatured alcohol and the exhaust gases from an alcohol engine are also not likely to be as obnoxious as the odor of gasolene and its products of combustion.

Very few alcohol engines are being used in the United States at present. Engines for all classes of work, designed especially to use denatured alcohol have, however, been tried with considerable success.

The price of denatured alcohol is at present greater than the price of gasolene, and the quantity of denatured alcohol consumed by an alcohol engine as ordinarily constructed and operated, is in general relatively greater than the quantity of gasolene consumed by a gasolene engine of the same type. Cheaper methods of production and improvements in engine economy are, however, to be expected.

When used as a fuel, denatured alcohol is not always exempt from restrictions placed on the use of gasolene by the rules of insurance and transportation companies or city ordinances. These restrictions, however, are never greater than those placed on the use of gasolene. In some places the use of an alcohol engine is permitted where a gasolene engine is prohibited. This is the case with many of the steamer piers in New York that are not open to gasolene-propelled vehicles.

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A Merry Christmas

The date of this issue being nearer Christmas day than that of the next, it is the appropriate number in which to extend to our readers and advertisers the greetings of the Christmas season, and certainly in comparison with that of either one or two years ago the situation is one which justifies such greetings. Many family tables which for two years have been strangers to the Christmas turkey will this year renew their acquaintance with it, and with the good cheer of which it is the symbol, and which is appropriate to the season.

To both our readers and advertisers we can offer something appropriate to the custom of the season—to the former, more pages, better paper, a new face of type and other changes in our make-up which will appear in the first issue of the new year, and which will make the paper, not only a better specimen of the printers' art, but easier to read; to our advertisers we present the increased publicity due to our German edition, which will appear in Berlin January 1, and to both we present these greetings which, although of necessity long since stereotyped in expression, are nevertheless heartfelt.

We like to think of our readers, who are found in practically every civilized country on the globe, as something more in their relation to us than buyers of what we have to sell, and, indeed, more than absorbers of the information which is found in our columns. Not only do we like to do this, but we have reason for it in the expressions of cordiality and good will which are constantly made in the voluminous correspondence which flows in upon us. Moreover, in view of the international character which our paper has now assumed, and the resulting international interchange of information and opinion, we like to think that we are doing a little toward that better understanding among the peoples of the earth, of the importance of which we are all constantly reminded.

First Year of Operation of Savings Bank Insurance

The first year of operation of the Massachusetts savings-bank insurance system closed October 31 last. The report showing results from the work of the insurance departments of the Whitman Savings Bank and the Peoples Savings Bank of Brockton gives the following:

"The aggregate insurance of the two banks outstanding at the end of the year (not including annuity or pension policies) was about $1,000,000—the policies being 2521, and averaging $393.79.

"The insurance departments earned, after setting apart the full legal reserve, calculated on the most conservative basis, and in addition an amount equal to 4 per cent. of the premiums to the trustees of the General Insurance Guaranty Fund, and paying interest at the rate of 4 per cent. on the special guaranty fund of $25,000 for each bank, a surplus from which they have declared payable to the holders of all of the monthly premium policies a dividend of 8⅓ per cent.

"For the payment of this dividend only 25 per cent. of the surplus profit earned is required. The remaining 75 per cent. of the profits is set apart as a surplus guaranty fund, it addition to the legal reserve and the contribution to the General Guaranty Fund referred to above. Of the expenses of the insurance department during the past year, over two-thirds has consisted of medical fees. The percentage of these to premiums is, of course, unusually heavy in the first year. The State actuary believes that when the system is in full operation, the dividend on the monthly premium policies will be much larger than 8⅓ per cent., and that a dividend of 20 per cent. may reasonably be expected."

Of this record those who worked for the establishing of the system may well be proud.

Interest was aroused in savings-bank insurance by calling attention to the abuses of industrial insurance; tremendously high cost to the policy holder, huge expense rate of the companies, and large number of forfeitures of policies. Since savings-bank insurance was inaugurated in Massachusetts the lessening of these abuses is marked. The original advantage of the banks over the industrial companies as regards rates and terms has been reduced one-half, through reforms that the companies have been led to put into effect.

Even now the present monthly savings bank rates are 15 per cent. less than the present industrial rates. In addition is the 8⅓ per cent. dividend noted above, which makes the real rate 23 per cent. less; for all savings-bank policies are participating policies. The prospect of a much higher dividend rate in the future indicates the possibility of a still greater advantage.

An effort was made last winter in the legislature of Massachusetts to allow industrial companies to write insurance under a "group" plan. That is, to establish a rate equal to their regular rate less the cost of solicitation and house-to-house collection, provided 100 or more policyholders in a society or organization would pay their premiums through the secretary of the organization. Rates were advertised for this plan lower than the savings bank rates. The "joker" lay in the fact that such policies did not guarantee participation. This fact was not mentioned. The importance of this is seen in view of the prospect of 20 per cent. dividends from the savings-bank insurance departments.

The immediate and unqualified success of this system of wage earner's insurance in Massachusetts should stimulate

interest in other States; interest that will lead to the adoption of similar systems for the benefit of those who are either entirely unprotected by insurance or who are preyed upon by the excessive costs of industrial insurance as ordinarily written.

Prevention of Accidents an Engineering Problem

Industrial accidents will be prevented by safety devices and in no other way. The force of public opinion may cause the general adoption of such devices, but upon the engineers is the duty of designing and applying them.

Many shops in this country today do something toward guarding dangerous parts of power-driven machines and dangerous places about the plants. With but few exceptions, however, the work is not thoroughly or systematically done. Guards are made from castings, sheet metal, screening, pipe, scantlings or combinations of any two, three or all of these materials. If a shield or cover of one material is most suitable in one location, it is also most suitable in a similar place on another machine. Instead of making them in a haphazard way they should be carefully worked out and standardized as far as conditions permit.

The result is but natural when we consider the average attitude toward the subject—indifference. The need of some kind of a safety device on or around a certain machine is seen, and in order to get it into use a handy machinist is told to make it as quickly and cheaply as possible. The question of intelligent, systematic design is not considered. An exception to this situation that must be noted is the guarding of gears on most machine tools. In general they are all that one can wish for in design and application.

The prevailing attitude toward accident prevention was exhibited in an address made before the Civic Federation by the Commissioner of Labor of New York State. He said in substance that organized factory inspection by trained inspectors is necessary and desirable; and that he can take ordinary intelligent men with only common school education and in a few weeks train them into competent inspectors, competent to analyze the operations of a machine, determine the points of danger and prescribe safeguards. With this position we must quarrel.

Factory inspection will never be what it should be unless the inspectors are trained engineers (not necessarily technically educated) as well as trained inspectors. The idea that any intelligent man can be made into a competent inspector by a few weeks' training is in keeping with prevalent slipshod ideas about the whole subject. The designing of the safety devices on a machine is as much an engineering problem as designing the machine itself; of the two indeed it is the more important. Money value can be set on the destruction of a machine, or on a machine that is useless for the purpose intended because of faulty design; but can any amount of blood money really compensate a young man for the loss of a leg or a hand, or a young woman for the loss of several fingers or an eye?

A trained engineer is always selected to take up the work of conserving natural resources as minerals or forests or water powers. Are not human bodies and lives of more value than these insensate things? Then, why trust their guarding and conserving to anyone not a trained engineer?

We can learn from Germany in this particular as in many others. The best of German engineering thought and experience has been spent in devising methods and safeguards and safety devices to reduce industrial accidents. Through systematic means the results of these studies are available to all who are connected with the industry to which they apply. Such investigations and reports are of incalculably more value than the essays on the subject of accidents, or sporadic descriptions of a safety device here and there, such as are printed in this country.

The prevention of accidents through safety devices is an engineering problem, and the sooner engineers are permitted to take it up the sooner will industrial accidents be reduced to their minimum.

Patent Medicine Tactics in an Engineering Monthly

Who has not been "stung"—to use a word from the small boy's vocabulary—by a patent-medicine advertisement that begins with the earmarks of an interesting general article and ends with "Take So-and-so's Light Silver Pills and live forever," or something equally as inspiring. Daily papers have been the sinners in the past; but now a recent issue of a well known engineering monthly presents a gem sired by the same inspiration.

The article describes a humorous adventure of an American professor on taking his typewriter into Germany, many years ago, and the customs inspector had difficulty in getting a proper classification for it. Thus far the reader is interested. Then the article continues: "He still uses a machine, however, but one which could under no possible classification be relegated to such a name; for he uses a ————." We leave blank the name of the machine, but it appears three times before the end of the article is reached.

But one word of comment is necessary: "Stung."

New Publications

THE STEAM ENGINE. By Charles H. Benjamin. 303 5¾x9-inch pages; 152 illustrations; indexed; 5 pages of tables in appendix. The Technical Press, Brattleboro, Vt. Price, $3.

This work has been written primarily as a textbook to cover the elementary principles of the steam engine and show their application to engine design, construction and operation. Its scope is best shown by quoting the chapter headings: Elementary Principles; The Simple Steam Engine; The Thermodynamics of Air; The Thermodynamics of Steam; Valve and Link Motions; Indicators and Indicator Diagrams; Compound Engines; Governors; Flywheels; Steam in the Cylinder; Condensers and Heaters; Piping and Flow of Steam; Steam Engine Performance; Steam Engine Design; Specifications and Costs. In general the field of each subject is adequately covered, and the problems worked out and given for solution are practical. However, the reviewer notes loose definition; three examples are: "Stress is an internal force exerted between the particles of a body and caused usually by the application of external forces." "The gas engine is simply a hot-air engine in which the air is heated by the explosion of gas inside the cylinder of the engine itself." "Boilers which supply wet steam are said to 'prime' or 'foam.'" The chapter on engine design is largely written from the work of Professor Barr, which was done some 10 years ago, and thus, although that was an admirable investigation, can hardly be said to represent the present-day practice. A recent investigation along the same lines carried out at the University of Wisconsin the author has apparently overlooked.

ACCOUNTING EVERY BUSINESS MAN SHOULD KNOW. By Elisha Ely Garrison. 188 4¾x7-inch pages. Doubleday, Page & Co., New York. Price $1.20, net.

The author's intimate acquaintance with his subject, combined with a happy faculty of expression has enabled him to really present a book that "every business man should know." Its purpose, to which it lives up, is "to explain away the obscurity which frequently hides the real values and purpose of accounting." Emphasis is laid upon the necessity of establishing a system of accounting that will speedily reveal fraud and dishonesty, and this thought is kept prominently before the reader. The chapter headings are: Origin and Foundation Ideas; The Transition to Modern Methods; The Reorganized Ledger System; Opening the Ledger; Closing the Ledger; Account Characteristics; Valuation and Reserves; Inventory Ledger; Expense and Revenue Ledger; Department Costs and Contingent Addition; Fundamental Principles of Cost Accounting; Devising of Systems; Statement of Results; Accounts and the Manager; Accounts and the Directors.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make it Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

Large Presses for Automobile Work

The accompanying illustrations show two new presses of unusual size intended specially for automobile work, which are the product of the Toledo Machine and Tool Company, Toledo, O.

The press shown in Fig. 1 is intended for pressing or forming the side and cross channels for the under frames of automobiles—a class of work that has heretofore been largely done on hydraulic presses. The lower die, which, with its mate, is shown in position, is fitted with a pressure attachment for preventing the distortion of the strip while being formed, this attachment having a capacity for sustaining a pressure of about 500 tons.

A novel feature, growing out of the great size and weight of the press, is a motor-elevating attachment. A 4-horsepower motor is mounted on the top of the frame arch, sprockets and link belts transmitting the power down to the rear shaft from which it is carried to the worm shaft, which engages the worm gears on the right and left pitman screws. Below the motor and concealed by the framework is a reversible clutch which gives control to the attachment by the lever and segment which are grasped by the operator's hand as shown in the illustration. The control of the ram movement is through a friction clutch fitted with hand-lever control.

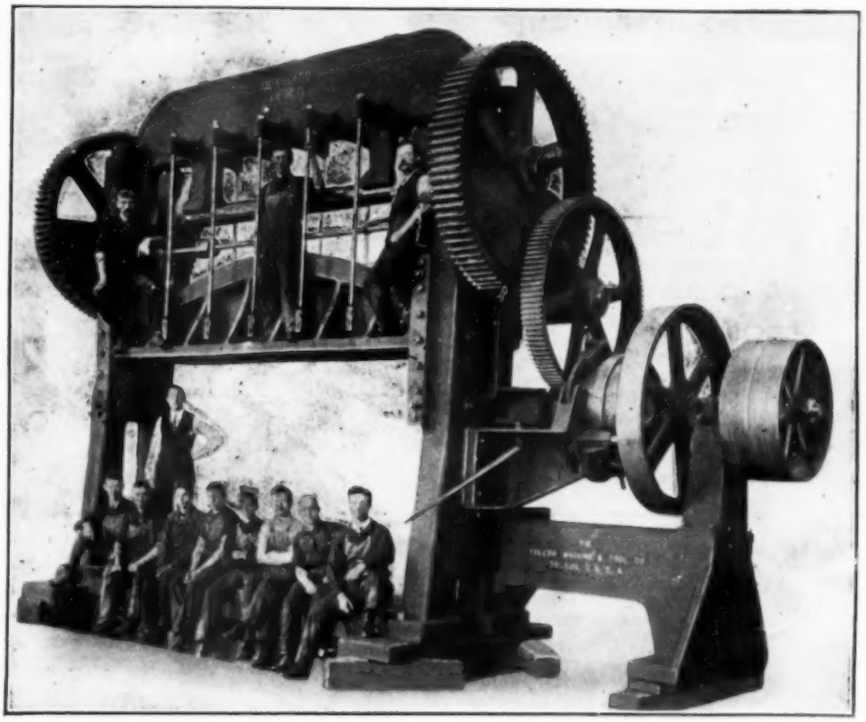


FIG. 2. PRESS FOR TOURING-CAR SEATS AND BODIES

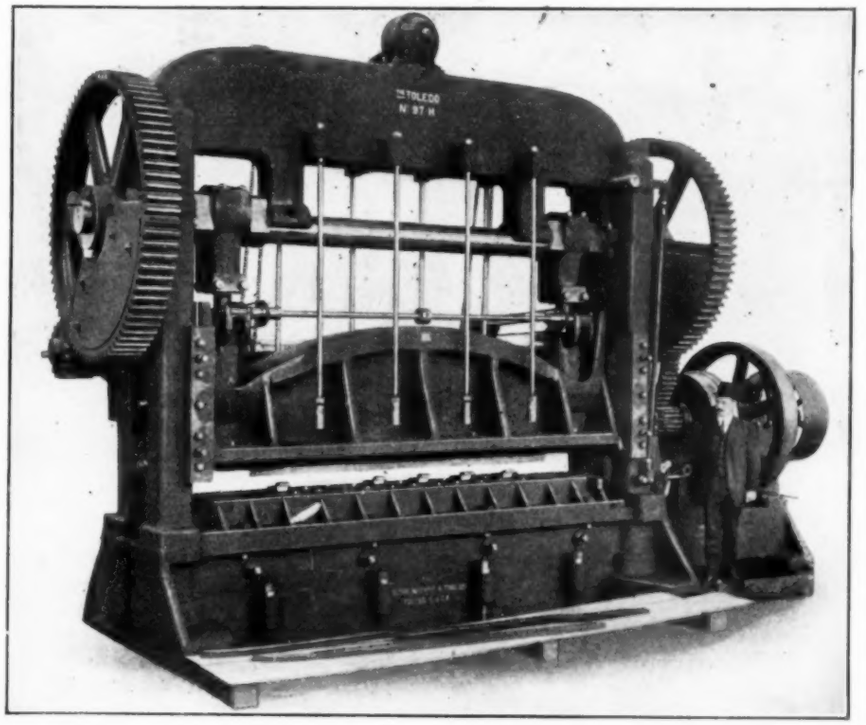


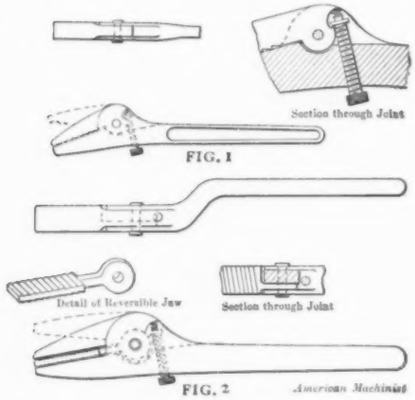
FIG. 1. PRESS FOR UNDER-FRAME SIDE AND CROSS CHANNELS

The press is operated at a speed of 8 strokes per minute and it has a ram pressure capacity of nearly 900 tons. The width is 14 feet 4 inches between housings, the stroke of the ram is 8 inches and the power required for operating the machine is about 40.

The press shown in Fig. 2 is for such parts of automobile bodies as require increased movement of the ram, including the seats and panels for touring-car bodies, to accommodate which a ram stroke of 24 inches is provided. A sub-base, not shown in the illustration, is attached to the top base, the sub-base being 40 inches high and, when in position, reducing the space between the base and slide to normal requirements for ordinary work. The bolster is made interchangeable between the main bed and the sub-base and this is also true of the drawing attachment used for operating the drawing and forming dies necessary for this class of work. The width of the press between housings is 12 feet 4 inches and it is operated at a speed of 6 strokes per minute.

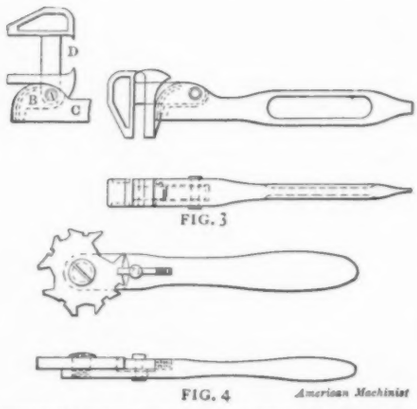
Four New Wrenches

The accompanying illustrations show four forms of wrenches which have been designed and patented by W. S. Ducharme, Johnstown, Penn. They require very little description, Fig. 1 showing an alligator wrench with an adjustable jaw, the construction being indicated by the section through the joint. In Fig. 2 is a somewhat different construction, the corrugated jaw being introduced between the two plain jaws so that it can be used in either direction. This is particularly desirable in this case as it is designed to be used near the ceiling, the handle being offset for this purpose.



ADJUSTABLE ALLIGATOR WRENCHES

Fig. 3 shows a self-adjusting combination wrench, the opening of the jaws depending on the angular position of the head and the handle. The head pivots around the pin *A*, and it can be readily seen that as the head moves in the direction of the arrow, the jaws are closed by the cam *B*. If the jaws are placed on a nut and the handle *C* moved in the proper direction for exerting power, the jaws automatically close against the sides of the nut, the grip being tightened as the pull increases. A pair of cutting jaws *D* are provided at the back of these, which are operated in the same way by the pull on the handle.



COMBINATION WRENCH, PLIERS AND SCREW DRIVER

Fig. 4 shows a wrench having a turret head to be used on five sizes of nuts.

The Rowbottom Universal Cam Cutter

Nearly all automatic machinery uses a number of cams and it was for this reason that this machine was designed and built by the Rowbottom Machine Company, Waterville, Conn. It will cut all kinds of rotary cams and both barrel and face cams can be cut with the same kind of a master cam.

The cutter head *A* carries the cutter spindle through a train of gears in the floating frame which preserves belt tension and gives four changes of speed, there being a two-step cone and back gears in the head. Both the head and the former block *C* are mounted on the long slide *B*, which is kept under control of the master cam by the weight *W*.

The feed mechanism is driven from the back by a separate belt and has four changes. This drives a feed shaft which turns both the master cam and the work at the same rate, regardless of the cross adjustment of the work head by the screw *E*, which is provided with a large micrometer dial for easily setting the depth of cut. The power feed is thrown in and out by the clutch lever *D*, while the feed can be operated by hand by the shaft *G*.

The master cam *M* is placed on the right-hand head and securely fastened by the driving stud shown in Fig. 2. The work is fastened to the other head as at *X* in its proper position for cutting. The slide *B* is moved to bring the follower roll *I*, held on a shaft in *C*, against the master cam, by using the crank at *F*. A scale on the head *A*, above the pointer *H*, shows the exact distance of the cutter from the center of the cam to be cut and, after the roll is against the master cam, the final adjustment is obtained by moving the block *C* on the slide *B*, by means of the handwheel and screw shown. This permits a single master cam to be used for several sizes as long as the throw of the cams are the same, which is sometimes an advantage with cams having very abrupt rises.

FIG. 3. SOME OF THE CAMS CUT

Fig 2 shows how the same machine can cut barrel cams and with the same

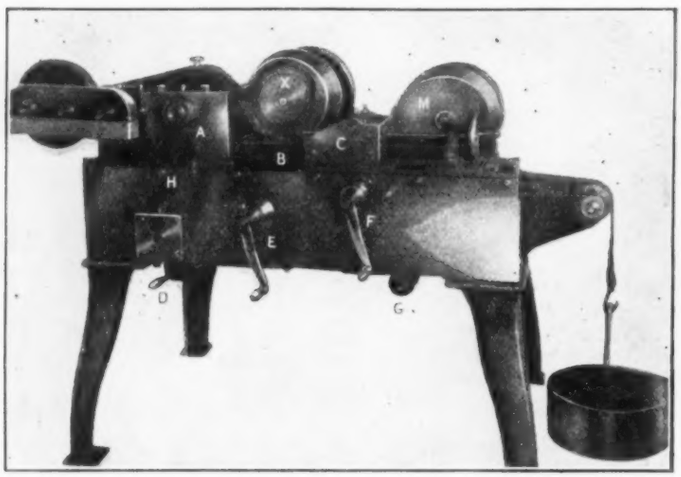


FIG. 1. THE ROWBOTTOM CAM CUTTER

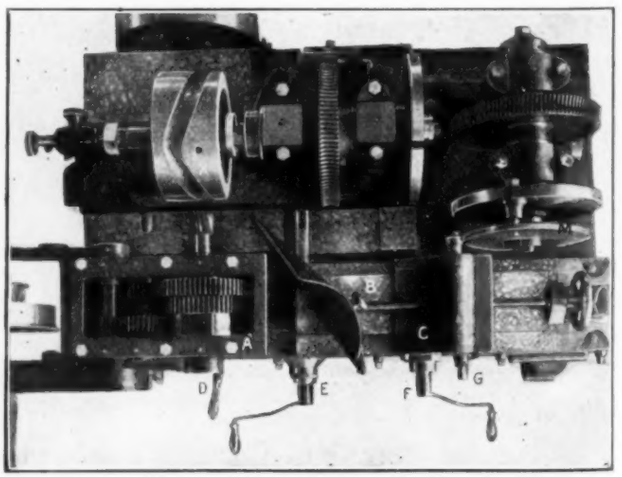


FIG. 2. CUTTING A BARREL CAM

master cam. The work head is driven by bevel gears from below and is simply turned 90 degrees, a tailstock put on to support the cam arbor, and the work proceeds as before. The cross movement of the work head gives the depth of cut and the heads turn at the same rate from the same feed shaft in spite of the heads being at right angles to each other. This view shows the cover of cutter head removed, the speed being changed by sliding the spindle gears to the front.

In both heads, the spindle and face plates are a single steel forging, which avoids all chance of the work or the master cam from loosening on the spindle. The machine will cut cams up to 16 inches in diameter and the arbor will hold barrel cams 9 inches long. Fig. 3 shows some of the cams that have been cut and gives a good idea of the work that can be done.

Flue Cutting Machine

The flue-cutting machine illustrated by the accompanying halftone is designed upon simple lines, and has a capacity for cutting tubes and pipes from ⅜ inch to 6 inches in diameter. The work can be

FLUE-CUTTING MACHINE

cut off at any desired length and the machine operates so as to be practically noiseless.

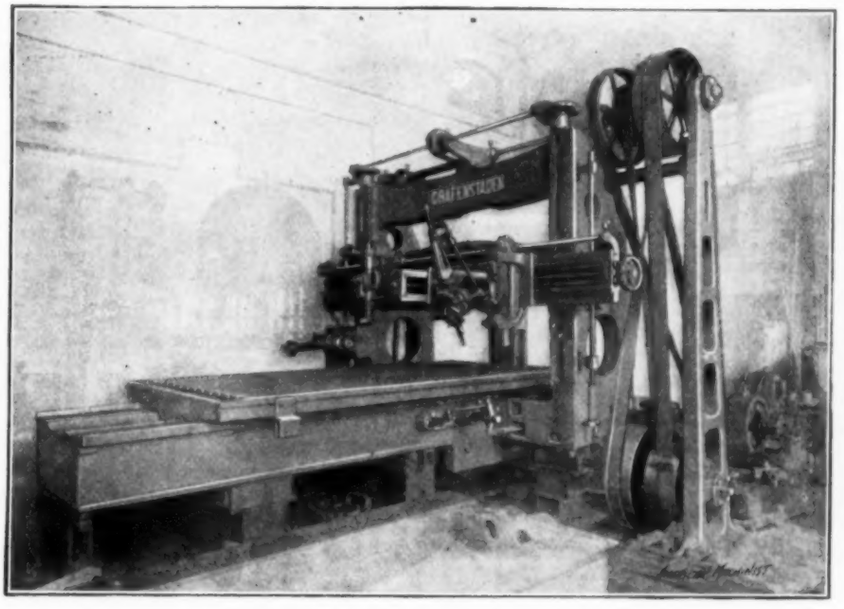
The cutter wheel is direct connected by means of a knuckle-joint shaft to a 12x3-inch pulley which should travel about 200 revolutions per minute. The object of the knuckle-joint drive is to permit the tubes or pipes to be run out back of the machine so that they may be cut to any desired length. The feed of the cutter is accomplished by means of the hand lever shown; balance weight being provided to secure an automatic release. The lever is so balanced that it requires but very little pull upon it to cut tubes of any size. The rollers on which the tubes revolve are arranged so they can be brought close together or spread apart quickly to the proper distance for taking care of the various sizes of tubes or pipe.

For reaming out the slight bur from the inside of the tube, which is sometimes caused by the cutting wheel, a fluted reamer is provided and attached to the end of the shaft as shown. This reamer will ream tubes up to and including 3 inches in diameter.

The machine weighs approximately 825 pounds and is being placed on the market by Joseph T. Ryerson & Son, Chicago, Illinois.

An Interesting Milling and Drilling Machine

The illustration shows a very interesting tool sent us from the Société Alsacienne de Constructions Mecaniques



PLANER-TYPE BED MILLING AND RADIAL DRILLING MACHINE

of Grafenstaden, Alsace. This is a machine of the planer type, but having the cross rail fitted with a head carrying a radial drill and also a head with a vertical milling spindle. This has evidently been designed for some special work where such a combination is particularly desirable and has a special arrangement of driving belt between the housing and the upright on the outside.

The radial drilling head is fully universal in its movements, the arm being of the trunnion type, and having power feed in every direction. Some idea of the size of this machine can be had when it is noted that the distance between the housings is about 11 feet, 6 inches.

The Thompson Tapping Chuck

This is a tapping chuck with a positive clutch instead of a friction so that adjustment is unnecessary and the release is not liable to be retarded by undue

TAPPING CHUCK

friction and to break a tap. The chuck shown is for use on machines having a reversing attachment to the head, such as radial and other drilling machines, and is very simple in construction. The clutch *A* goes up into the body, followed by the tap holder *B*, the whole mechanism being held in place by the collar and screws shown.

The rod *C* runs through the tap and is adjusted to project the correct distance to act when the hole has been threaded

deep enough. When the rod strikes the bottom of the hole, it lifts the clutch *A* against the spring pressure behind it and releases the tap bushing.

This is made by the Pawtucket Tool Company, Cottage and Saunders streets, Pawtucket, R. I.

Coil Clutch

This is the invention of an English sailor who had studied the action of the rope on a windlass as it is used to raise and lower heavy weights and the same idea has been embodied in the clutch shown. It consists essentially of a steel spring coiled around the piece to be held, in this case a chilled roll, a slight tightening of the coil giving a very large frictional contact and a corresponding loosening releasing the grip instantly.

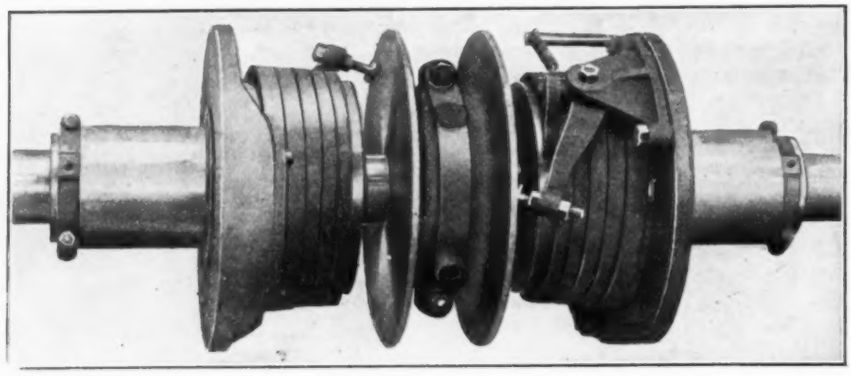


FIG. 1. STANDARD TYPE COIL CLUTCH

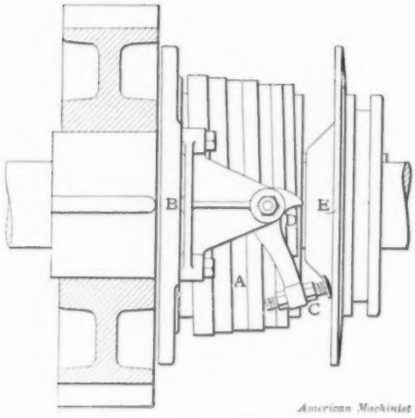


FIG. 2. DIAGRAM OF CLUTCH

The coil spring *A*, Fig. 2, is hand-forged from a high grade of spring steel and anchored at *B* under the support for the clutch arm *C*. The inside of the coil is bored out to receive the chilled drum or shaft of the other member of the combination which also carries the clutching spool *E*. The outer end of the coil has an ear *D* which engages the hook at the back end of the arm *C*, so that, as *C* is forced back by *E*, the spring is coiled a little tighter and grips the chilled drum inside.

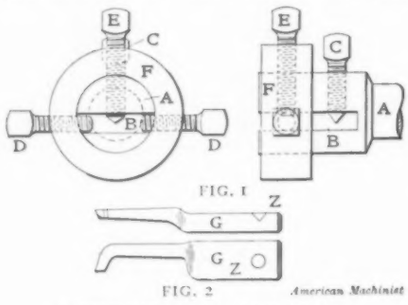
The springs are so proportioned that they are entirely free from the inside drum when out of engagement and that the tightening is so gradual, yet positive, that it picks up the load without shock and carries it until released.

They are made in all sizes from a 4-inch drum for 6 horsepower at 100 revolutions per minute, up to 8000 horsepower at 60 revolutions per minute. It will be readily understood that the power transmitted by any given size will depend on its speed. These are built in this country by the Farrel Foundry and Machine Company, Ansonia, Conn., who have already applied them in many cases of severe service.

A Roughing Tool and Holder for Monitor Lathe

By J. K. Peters

Fig. 1 represents a boring-tool holder which is used on the monitor lathe. This tool is especially valuable for roughing out cored holes in brass castings. Letter *A* indicates the body and *B* the slot for the boring tool; the style of tool is shown in Fig. 2.



A ROUGHING TOOL AND HOLDER

To set this tool for boring, the forged tool *G* is placed in the slot *B* and the pointed screw *C* is set in the countersunk hole *Z*. It can now be seen that while the tool is held in this manner it will swing on this pivot. At *D D* are adjusting screws to move the tool in either direction. Screw *E* holds the tool in place when the proper adjustment has been made. The collar *F* is for holding screws *D D*, and reinforcing body *A*.

Aluminum, Its Alloys and Impurities

By E. F. Davis*

Aluminum is perhaps the most widely distributed metallic element on earth. Mica, feldspar, clays, cryolite, corundum and soils all have it in their composition. Precious stones, the ruby and sapphire are oxides of aluminum. We drink it every day for it exists in small percentages in the solid matter of a number of natural waters. In fact, 7.81 per cent. of the earth's crust is aluminum. But it forms such stable compounds and associates with the metalloids so tenacious that its reduction has only been made practical and profitable within the past 25 years.

It has a great affinity for oxygen, at high temperature, 114 parts of aluminum combining with 100 parts of oxygen. This property makes it valuable to the steel industry where it is added to the molten mass in small amounts to absorb the gases, quiet the steel, and permit the pouring of "wild" heats with the results of sounder and finer-grained castings. The presence of aluminum itself in the steel weakens it and hence there is only enough placed in the ladle to remove the oxygen and pass off with the slag.

Aluminum can be drawn into the finest wire (ductility) and beaten into thin sheets (malleability). In a finely powdered state, aluminum burns very rapidly with a brilliant white light and mixed with potassium chlorate and other oxidizing mediums is used to some extent, instead of magnesium, as flashlight powder in photography.

Effect of Titanium, Iron and Silica

The natural impurities that are ordinarily found in reducing aluminum are calcium, silica, iron, titanium and the alkaline metals; of which sodium and potassium are the commonest. I have never found calcium or titanium existing as impurities after reduction, as these metals are evidently very easy to remove if present in the bauxite. But according to experiments titanium as an alloying element is beneficial to aluminum if not over 3 per cent. is used. The strongest of the alloys is one containing 2 per cent. of titanium, which has a tensile strength of 32,000 pounds. These alloys are not

*Chemist, Warner Gear Company, Muncie, Ind.

bright like the pure aluminum but have a dull lead-like appearance.

The effects of iron and silica are that they make a casting brittle and hard to machine. An aluminum transmission case, used on automobiles had the following percentages of ingredients: Copper 8.75, iron 1.57, silica 0.87, aluminum 88.81. It took between three and four hours to machine this; while another case with the following: Copper 6.04, iron 0.26, silica a trace and aluminum 93.64, was machined all over in only one hour. The higher amount of copper in the first sample increased the hardness somewhat but I have found whenever the iron and silica are relatively high that difficulty was experienced at the machines. Hence it is advisable to keep these impurities as low as possible.

Effect of Alkaline Metals

Sodium and other alkaline metals are very bad impurities in aluminum, especially in the alloys low in copper. While they do not affect the physical properties to any extent, if in small quantities, they do cause them to corrode very rapidly as is shown in the illustration. These were exposed only to the action of moisture and other atmospheric conditions. My opinion is that the presence of copper in the alloy is an aid to corrosion, as these two metals are relatively far apart electrochemically.

When moisture gathers on the surface, a potential is set up, thus forming an electric current that liberates one atom of hydrogen which is replaced by an atom of the sodium of potassium, or whatever alkaline metal is present. This forms an alkaline hydrate that in turn attacks the pure aluminum and displaces the alkaline metal which combines with the more nascent OH_2 and so continues indefinitely in destructive cycles.

A solution of sodium chloride placed in a glass jar wherein are placed two electrodes, one of copper and one of pure aluminum, connected with a piece of wire, soon becomes clouded with insoluble aluminum hydrate. The corrosive action of sea water, which contains these salts, upon aluminum-copper alloys, low in copper, bears this hypothesis out as correct. These alloys will also corrode for the same reason if brought into contact with damp earth for any length of time. Hence, aluminum castings should be protected as much as possible from direct exposure to the weather.

On the other hand, aluminum bronze is incorrodible under these same conditions but this is owing to the fact that the aluminum present has united with the copper and formed a compound of copper. As the potential between copper and the copper compound is not great, and as copper itself is not affected by these hydrates there is no corroding influences existing.

Aluminum-copper Alloys

As to alloys, aluminum combines to some extent with all the common metals except lead, and also with many of the rarer ones. The principal alloying material is copper. It forms two sets of alloys: one with the aluminum low and the other with the copper low. These two metals unite to form a chemical compound, with a formula of $CuAl_2$, that is hard and crystallizes out in a matrix of pure aluminum. This increases the compression and breaks the fibrous structure of the pure metal; thus makes it easier to bore, ream, and cut smooth threads. The tensile strength of these alloys, low in copper, is increased from 12,000 to 20,000 pounds per square inch.

Notwithstanding the fact that most founders are running the copper to from 8 to 12 per cent., nothing is gained when over 4 per cent. is used, as at this point

EFFECT OF ATMOSPHERIC CONDITIONS ON ALUMINUM CONTAINING ALKALINE METALS

the alloy has reached its highest efficient strength and the further addition of copper only increases the weight of the alloy. Carpenter and Edwards, of the Alloy Research Committee, state in their reports "that over 4 per cent., there is a decrease in ductility without any corresponding increase in tenacity."

Aluminum Brass and Bronze

Aluminum bronze to wear well should not contain over 10 per cent. of copper nor under 7½ per cent. A bronze with 92 per cent. of aluminum and 8 of copper makes an excellent alloy. Beyond 10 per cent. they are exceedingly brittle. Continued heat such as the heat of friction enlarges the crystals and makes the metal weaker. Annealing also has the same effects. These properties are common with many other bronzes, but the superior strength and wearing qualities of the aluminum bronzes make them far better as a bearing metal.

In foundry work the bronze, after the alloying, should be remelted at least twice as only the best service can be obtained when they are homogeneous, and if only melted once, there is more or less segregation.

Brass is much improved by the addition of aluminum in percentages of from 4 to 10. Excellent castings are thus obtained owing to the fluidity in pouring that is due to the presence of aluminum and the freedom from blow holes. It strengthens brasses considerably. A brass containing 64 per cent. copper and 36 per cent. of zinc has a tensile strength of about 28,000 pounds per square inch; while the addition of but 2½ per cent. of aluminum raises this strength to 65,000 pounds per square inch. These brasses can be forged at a red heat. The principal difficulty is in burning out the zinc and changing the composition when remelting. Hercules metal is an aluminum brass that contains iron.

Aluminum-zinc Alloys

Aluminum containing less than 50 per cent. of zinc forms a solid solution that does not crystallize out like copper. By solid solution is meant that the particles become so intimately mixed that the highest microscope cannot detect the two metals and yet they are not in compound with each other.

If the content of zinc is under 15 per cent., the alloys will be soft enough to be drawn or rolled but from 15 to 26 per cent. give the best alloys for castings. Above 25 per cent. they are extremely hard and though further additions increase the tensile strength to as high as 35,000 pounds per square inch, their hardness makes them impractical for ordinary commercial use.

The two unfavorable features of zinc alloys are first the difficulty of obtaining uniform castings with a standard tensile strength owing to the liability of losing zinc by vaporization; and the fact that it requires so much of the alloying metal to secure a sufficient strength.

These alloys are very useful where lightness is of primary importance, and, when combined with about 5 per cent. of copper are very valuable where great strength and rigidity are required in castings.

Effect of Nickel

Nickel forms an important alloy with aluminum and like copper unites and forms a chemical compound with the formula $NiAl_6$, which is very hard and is embedded throughout the pure aluminum. Only those containing less than 5 per cent. of nickel are of much value as the hardness increases very greatly above this.

Nickel increases the tensile strength

considerably higher than copper and is sometimes used with it as a hardening agent. The nickel alloys do not resist corroding influences as well as some of the other alloys.

Aluminum-Magnesium Alloys

The high price of magnesium makes its aluminum alloys prohibitive for ordinary commercial use, but its beneficial effect makes it worthy of more than passing notice. These alloys are especially valuable owing to their exceeding lightness, combined with their strength.

Magnesium itself has a specific gravity of 1.58 which is much lighter than aluminum. Two per cent. of this metal makes a soft alloy and 5 per cent. a harder one; both being suitable for rolling. They are still harder between 5 and 15 per cent. and within these limits are suitable for casting. Over 25 per cent. the alloy becomes too hard for working and the brittleness also increases until at 50 per cent. they may be crumbled easily with the hand. Magnesium hardens almost as well as copper and is in itself a great oxidizer, as it reacts on the uncombined oxygen within the aluminum, with a very beneficial effect to the metal.

The aluminum-magnesium alloy is far superior to any of the others and were it not for its high cost, it would speedily supplant them in the automobile industry. Copper, lead, nickel and other metals are sometimes alloyed with it with good results. An alloy known as magnalium has the following analysis: Aluminum, 95.50 per cent.; magnesium, 1.50; copper, 1.50; nickel, 1.50. The composition varies some but this is an average alloy.

Magnalium is not affected by organic acids and therefore may be used with great satisfaction in cooking utensils and other culinary apparatus.

Manganese, Chromium, Antimony and Bismuth

Manganese, like magnesium and zinc, forms a solid solution with the aluminum when used under 10 per cent., but beyond this it crystallizes out and becomes too hard for ordinary commercial purposes. Five per cent. will make a good, strong alloy. The tensile strength of an alloy of copper, zinc and aluminum, together with manganese, has been raised as high as 35,000 pounds per square inch.

Almost all metals alloying with aluminum have a tendency to harden it. Chromium is an excellent metal if used in small quantities. Two or three per cent. is all that is allowable for over this the alloy becomes very dense and loses its malleability, and when 5 per cent., it is unworkable.

Antimony and bismuth have not as yet been used with any success. They give a conglomerated structure to the alloy which is very brittle and breaks with an uneven fracture.

Effect of Tin

Tin causes great brittleness even when added in very small quantities. The fracture has a fine, white, crystalline structure. An alloy containing 10 per cent. of tin, according to Minet, has a specific gravity of 2.85; a tensile strength of only 14,000 pounds, and very little ductility. These alloys are useless in the automobile industry as the alternating stresses due to vibration would soon break them.

Tin decreases the shrinkage in castings and when sharpness of outline and stiffness are of primary importance, these alloys are sometimes used. Its use is not to be recommended, however. These alloys are more fusible than the pure aluminum and have been used as solder, but with no marked success, owing to the heat conductivity of aluminum, which prevents any local heating and the constant formation of a thin film of oxide that prevents the solder from taking hold.

Small amounts of aluminum added to tin as a hardening agent exert a very beneficial effect but after a length of time the alloy has a disposition to disintegrate.

Tungsten, Cobalt and Molybdenum

Tungsten hardens aluminum and increases the resistance to corrosion. It may be used in small quantities in the presence of other metals, with great satisfaction. A tungsten alloy is used in Europe to some extent under the name of Wolframium. A 7½-per cent. alloy shows a tensile strength a little higher than the aluminum-copper alloys of the same description.

Cobalt and molybdenum are also good hardening agents but are not used to any extent, owing to their high cost.

Conclusions

The aluminum industry is in its infancy, as yet, and no doubt in time alloys will be produced that will surpass any that are in present use. The development of the motor car, the progress in aviation and continued researches in electrical phenomena are calling the attention of metallurgists to this element.

All of the metals harden it to some extent, but most of them form such conglomerated structures that their use is very limited. The copper and zinc alloys are the most used in the automobile industry where, as castings, they find use as transmission and crank cases, steering spiders and housings for gears in the controlling apparatus. Bronze alloys have been used as bearings.

Forthcoming Meeting

American Society of Agricultural Engineers, third annual meeting, December 28-29, 1909, Ames, Ohio. F. W. Chase, secretary, University of Nebraska, Lincoln, Neb.

Business Items

The machine tool equipment of the Dayton Hydraulic Machinery Company has been sold to the Patterson Tool and Supply Co., Dayton, Ohio.

The Chicago offices of the Reeves Pulley Company have been moved to larger quarters at the northeast corner of Clinton and Monroe streets. A complete stock of power-transmission appliances will be carried. E. O. Winterowd is manager.

The Mumford Molding Machine Company has been organized and will sell the foundry molding machines heretofore sold by the E. H. Mumford Company, of Philadelphia. These molding machines will be manufactured for the new company by the Q. M. S. Company, at Plainfield, N. J., and the Mumford Molding Machine Company will have its sales office at 30 Church street, New York City. W. D. Sargent is president and E. H. Mumford vice-president and general manager of the new company.

Business Opportunities

Byron Reed Company, Omaha, Neb., will erect a garage.

J. D. Clifton, Peru, Neb., will erect a blacksmith shop.

J. S. Crisler will erect a box factory at Rice Lake, Wis.

Nels Rasmussen, University Place, Neb., is building a garage.

The Sandstone (Minn.) Creamery Company will erect a plant.

H. J. Humphrey will erect a shingle mill at Florence, Wash.

The Oswald Motor Company, Goshen, Ind., will enlarge its plant.

Henry Gruenberg will erect a blacksmith shop at Verdigris, Neb.

The Nebraska Cement Company, Superior, Neb., will erect a plant.

The City Carriage Works, Fort Wayne, Ind., will enlarge its plant.

A. Freedman will build a garage at 581 Lake Drive, Milwaukee, Wis.

The National Produce Company, Sioux City, Iowa, will erect a creamery.

The National Lock Company, Rockford, Ill., is erecting a new factory.

The Western Banana Crate Company, La Crosse, Wis., will build a plant.

The plant of the Pulaski (Va.) Foundry and Machine Works was burned.

The Tri-City Plate Ice Company, Davenport, Iowa, will erect an addition.

The Conradson Automatic Lathe Company, Madison, Wis., will erect a factory.

The Woodward Governor Company, Rockford, Ill., is erecting a new plant.

The American Cotton Oil Company, Guttenberg, N. J., will build two additions.

R. H. Duncan, Dubuque, Iowa, will erect a factory for ceiling and cornice work.

Godfrey & Sons, Milwaukee, Wis., will establish a creamery at Tomahawk, Wis.

The Flour City Ornamental Iron Works, Minneapolis, Minn., will enlarge its plant.

A. Endrich & Sons, Frankford, Penn., is erecting a three-story addition to brewery.

The Milton Rogers Estate will erect a garage at 2103 Farman St., Omaha, Neb.

It is reported the Pullman Car Company, of Chicago, will erect a plant in Detroit.

The plant of the Seneca Chain Company, Kent, Ohio, was burned. Loss, $150,000.

The Manhattan Oil Company, Des Moines, Iowa, will erect a plant in St. Paul, Minn.

Henry Doerr, of the Minneapolis (Minn.) Drug Company will erect a $25,000 garage.

The Colburn Automobile Company, Denver, Colo., is having plans drawn for a new plant.

The Centennial Flour Mill, Milwaukee, Wis., was burned. Loss, $200,000. Will be rebuilt.

The United Wireless Telegraph Company, of New York, will erect a plant in Jersey City.

The Model Mills Company, Philadelphia, Penn., is erecting a new five-story building.

A. M. Weidenbach has secured a franchise for an electric-light plant at Bridgewater, S. D.

A machine shop will be erected at Eveleth, Minn., for the Adams Mine Stripping Company.

M. R. Water & Son, 1400 Hennepin avenue, Minneapolis, Minn., will erect a $12,000 garage.

The planing mill and carpenter shop of the Great Falls (Mont.) Lumber Company were burned.

The Glazed Cement Sewer Pipe Company, of Tacoma, Wash., will erect a plant in Kenton.

The plant of the Preston Brick Company, Hornell, N. Y., was burned. Loss, about $40,000.

The H. J. Hartman Company, Grand Rapids, Mich., is erecting an addition to its foundry.

Thorn Architectural Iron Works, Philadelphia, Penn., is making extensive alterations to its plant.

The University of Pittsburg, Penn., is making preparations for the erection of 24 new buildings.

The Mechanical Rubber Company, Cleveland, Ohio, will erect two additional factory buildings.

The Firestone Tire and Rubber Company, Akron, Ohio, is having plans prepared for a new plant.

Mike Maroney, Storm Lake, Iowa, will remodel an existing blacksmith shop into a wagon shop.

The Alva Mills, Frankford, Philadelphia, Penn., making rugs and carpets, is erecting an addition.

The National Tube Company has made an appropriation of $52,000 for improvements to its plant at Kewanee, Ill.

W. Ames & Co., Jersey City, N. J., manufacturing bolts, spikes and bar iron, will erect a new plant.

C. Schmidt & Sons, Philadelphia, Penn., is building an addition to their brewery to cost about $50,000.

The plant of the Colton Combination Tool Company, Easthampton, Mass., will be moved to St. Albans, Vt.

The Lapointe Machine Tool Company, Hudson, Mass., has awarded contract for an addition to its plant.

The Milbourne Lumber Company, Philadelphia, Penn., is going to make extensive alterations in engine room.

The plant of the Corn Belt Packing Company, Fort Dodge, Iowa, has been destroyed by fire. Will be rebuilt.

The Schatz Manufacturing Company, Poughkeepsie, N. Y., is putting up a new plant for manufacturing hardware.

The Cupfer Bros. Company, of New York, manufacturing embossed paper, will erect a plant in Worcester, Mass.

The Hyde-Murphy Company, of Ridgway, Penn., will move its mill and woodworking factory to Du Bois, Penn.

The Standard Brass Foundry Company, Cleveland, Ohio, has let contract for the construction of a new building.

The Woeber Carriage Company, Denver, Colo., has purchased site for a new plant for the manufacture of street cars.

H. M. Rouscher, D. O. Friend and W. H. Lloyd will erect a cement, tile and building block factory at Brighton, Iowa.

The Porcelain Enameling Company, Sheboygan, Wis., has let contract for addition to its plant to cost about $75,000.

The Carr, Ryder & Adams Company, Dubuque, Iowa, making sash, door and blinds, will build an addition to its plant.

The Friedberger-Aaron Manufacturing Company, Philadelphia, Penn., braids and laces, has purchased site for a new plant.

The electrical and carpenter shops of the No. 2 Spruce Adams mine at Eveleth, Minn., were destroyed by fire. Loss, $30,000.

The New Departure Manufacturing Company, Bristol, Conn., will erect another building to be used as a hardening department.

The American Conduit Company, East Chicago, Ind., would like to receive catalogs from machinery and mill-supply companies.

The Philadelphia (Penn.) Rapid Transit Company will build an addition to its power house at Thirty-third and Market streets.

The planing mill and box factory of Jones-Baker Manufacturing Company, Houston, Texas, was destroyed by fire. Loss, $15,000.

The International Machine and Screw Company, Springfield, Mass., is to put up a new plant for the manufacture of its machines.

The plant of the U. N. Roberts & Co., Davenport, Iowa, manufacturers of sash and doors, was destroyed by fire. Loss, about $200,000.

H. E. Soule, representing the National Briquetting Company, of Minneapolis, is contemplating the establishment of a plant in Kenmore, N. D.

The Metallic Electro Purification Company, of Toledo, Ohio, will build a plant in Chattanooga for the manufacture of machines for purifying water.

The Puritan Electric Heater Company, Detroit, Mich., will build a new plant for the manufacture of electric flatirons, heating appliances, etc.

The W. H. Compton Shear Company, Newark, N. J., will erect additions to its plant, including forging shop and a general manufacturing building.

The plant of the Gheens Manufacturing Company, Lincolnton, N. C., was burned. Loss, $20,000. The company made all kinds of wooden products.

The plant of the Racine (Wis.) Manufacturing Company was destroyed by fire. Loss, about $600,000. The company manufactured auto carriage bodies, etc.

The Gardner Machine Company, Beloit, Wis., manufacturing disk grinders, has increased its capital stock to $100,000, and contemplate erecting a new factory in the spring.

The West Steel Casting Company, Cleveland, Ohio, making steel castings by the converter process, has enlarged its plant and is installing crucible furnaces to supply small castings for the automobile and general trade.

The plant of the Wonham & Magor Car and Manufacturing Company, Athenia, N. J., was destroyed by fire. Loss, about $70,000. Plant will be rebuilt. Machinery for the manufacture of steel and wood industrial cars will be needed.

The Jacobson Machine Manufacturing Company, Warren, Penn., building stationary gas engines, is erecting an addition to its plant, to be equipped with motor-driven machine tools. The company will also engage in the manufacture of automobile engines and parts.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., December 27, for steel, iron, copper, brass, zinc, wire, rivets, screws, nuts, nails, cotters, valves, hammers, saws, milling cutters, files, jacks, leather belting, etc., as per Circular No. 547.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: January 4—Vanadium steel forging, machine steel (schedule 2069); steel angles, steel plates, spring steel (schedule 2074); bolts and nuts, high-speed drills, twist drills, pipe taps and dies (schedule 2073); 10-inch slotting machine (schedule 2063); January 18—Centrifugal pump and motor (schedule 2081); vertical triplex pump (schedule 2065).

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: December 28—Self-lubricating bearings, bushings and sheaves, hacksaw blades, twist drills, brass machine and wood screws, taps and dies, hand taps (schedule 2049); 2-kilowatt generators (schedule 2040); January 4—Draw bench (schedule 2062), standard planer (schedule 2061); January 11—Files, wire nails, machine screws, spare machine tools (schedule 2057); forging equipment for tools (schedule 2042); milling machine, boring mill (schedule 2043).

New Incorporations

Plotner Can Company, Boston, Mass. Manufacture cans. Capital, $100,000. Incorporators, H. P. Small, A. L. Plotner.

Enterprise Garage Company, Brooklyn, N. Y. Capital, $25,000. Incorporators, F. A. Sands, N. Campbell, Brooklyn; J. R. Rubin, New York.

Marsh-Capron Manufacturing Company, Chicago, Ill. Manufacture machinery. Capital, $100,000. Incorporators, H. D. Crocker, G. V. Stibgen, G. T. Noxon.

Sauer Power Generating Company, Camden, N. J. Manufacture motors, engines, etc. Capital, $100,000. Incorporators, A. Sauer, H. J. Voegtle, V. A. Murray.

Reliable Electric Company, Chicago, Ill. Manufacture electrical supplies. Capital, $30,000. Incorporators, F. W. McNeal, O. C. Junge, G. W. Rodormer.

Park Square Automobile and Taxicab Company, Portland, Me. Manufacture and deal in automobiles, etc. Capital, $500,000. Clement F. Robinson, president.

Syracuse Gas Engine Company, Syracuse, N. Y. Manufacture gas and gasolene engines. Capital, $150,000. Incorporators, F. C. Eddy, L. S. Chapman, E. J. Paradis.

Rochester Carrier Company, Rochester, N. Y. Manufacture boxes, baskets, etc. Capital, $25,000. Incorporators, J. B. Miller, H. E. Kindoff, A. R. Turner, etc.

Harvard Paper Company, Portland, Me. Manufacture and deal in paper, leather, cloth, etc. Capital, $150,000. David L. Bradt, Somerville, Mass., president.

Vapor-Vacuum Heating Company, Camden, N. J. Manufacture heating apparatus. Capital, $125,000. Incorporators, A. M. Garrison, Geo. S. Yerkes, A. S. Flowers.

Victor Motor Truck Company, Buffalo, N. Y. Manufacture vehicles, motors, engines, etc.

Capital, $30,000. Incorporators, H. B. Clark, O. L. Neal, B. E. Neal.

Patent Steam Flat Iron Company, New York. Manufacturing flatirons and hardware. Capital, $50,000. Incorporators, J. Ginsburgh, W. E. Jacobs, J. S. Watson.

The Union Brass Works, Lansing, Mich. Manufacture brass goods and automobile supplies. Capital, $30,000. Incorporators, C. F. Coda, Geo. W. Borne, John Dadie, etc.

Gross-Brown Manufacturing Company, Galesburg, Ill. Manufacture refrigerators and ice-cream freezers. Capital, $50,000. Incorporators, A. B. Brown, J. Gross, B. Michelson.

Somerville Stove Works, Somerville, N. J. Manufacture stoves, ranges, heaters, etc. Capital, $125,000. Incorporators, Michael Baum, Chas. L. Voorhes, Jas. I. Ten Eyck.

Flandrau Motor Car Company, West Nyack, N. Y. Manufacture motors, engines, machines, carriages, flying machines, etc. Capital, $52,500. Incorporators, D. T. Wilson, R. C. Wilson, W. Moffat, New York City.

New York Wire and Spring Company, New York. Manufacture wire and wire products, nails, etc. Capital, $50,000. Incorporators, R. C. Moodey, Painesville, Ohio; W. A. Comstock, Cleveland, Ohio; G. T. Church, New York City.

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Successful superintendent of experience in the manufacture of small parts for a complicated machine, capable of handling and carrying on systematic and orderly and economical production; now employed. Box 999, AM. MA.

MICHIGAN

Wanted—By first-class mechanic, well up in modern machine shop and tool room practice, position as assistant superintendent or general foreman; can furnish best of references; location not material. Box 8, AM. M.

Shop superintendent or foreman; practical mechanic and executive in machine building, cost reducing and up-to-date methods of manufacturing interchangeable parts; 20 years' experience; best of references. Box 17, AM. M.

NEW JERSEY

Expert technical machine designer with eight years' experience on laundry machinery, electrical apparatus, punch presses, mailing machines and high capacity multiple operation, machine tools of various kinds desires change. Box 10, AMERICAN MACHINIST.

Salesman—Machine tool salesman as sales manager, having 15 years' experience, both in the manufacture and selling of machine tools; competent judge of condition and value of second-hand and familiar with all makes in the United States; can give best of reference. Box 790, AMERICAN MACHINIST.

Office executive and systematizer, 33, thoroughly trained, seeks responsible position; 15 years' machine manufacturing experience; master of all office details, excellent correspondent, experienced advertiser, good executive ability and an organizer with capacity to do things; references the best. Box 6, AMERICAN MACHINIST.

NEW YORK

Engine designer and mechanical draftsman with shop experience, 33, technical graduate, desires responsible position. Box 12, AM. M.

Thoroughly competent draftsman and designer desires responsible position with progressive concern in Greater New York; good mechanic. Box 991, AMERICAN MACHINIST.

Position in New York City wanted by mechanical-electrical engineer; fifteen years' experience, design and construction of machinery and buildings, shop and office systems, tests, reports; graduate Massachusetts Institute Technology; now employed. Box 20, AM. M.

Salesman, with thorough technical education and nine years' successful selling experience requiring engineering ability, wishes position with manufacturers of power transmission machinery and specialties; automobile accessories or any device, the sale of which requires a man of his caliber; highest references. Box 990, AMERICAN MACHINIST.

PENNSYLVANIA

Position wanted as assistant superintendent or general foreman by practical man understanding rapid production of interchangeable parts, raw to finished product; also tool design for same; now holding similar position. Box 11, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

ALABAMA

Wanted—A first-class machinist who is familiar with pattern and jig work; steady employment to the right man; only reliable, sober men need apply. J. C. Burns, Superintendent, Continental Gin Co., Prattville, Ala.

CANADA

Wanted—General foreman in a department manufacturing transformers in small and large sizes. Apply stating experience to Canadian General Electric Co., Peterboro, Ont.

CONNECTICUT

Wanted—Tool draftsmen; preferably those having had experience on automobile tools. Apply to the Pope Manufacturing Company, Hartford, Conn.

Wanted—Experienced mechanical draftsmen for detail work, in a concern manufacturing general rolling mill and hydraulic machinery; state age, experience and salary expected. Box 796, AMERICAN MACHINIST.

ILLINOIS

Wanted—Mechanical engineer, draftsman and designer, exclusively for building presses, automatic machinery and dies for sheet-metal work; state experience and give references; location Middle West. Box 15, AMER. MACH.

Wanted—Diemakers; high-grade men for small accurate work; toolmakers for gage, jig and fixture work; milling-machine operators for tool-room work; automatic screw-machine operators for Brown & Sharpe and other automatic screw machines; on this line of work we pay competent men 39 cents per hour; added premiums will make this rate average 42 cents per hour; hand screw-machine operators. In answer give full information. Address Department 1056, Western Electric Company, Chicago.

MASSACHUSETTS

Wanted—A general superintendent for a large manufacturing company in southern New England; salary $4000 to $5000 per year. Address "M. B. S.," AMERICAN MACHINIST.

MICHIGAN

Wanted—Ten first-class toolmakers who have tools and understand jig and fixture work; customary wages. Box 936, AM. MA.

Wanted—Experienced gunbarrel and gun frame bluer. Please state experience, rate of wages expected, etc. Box 3, AMER. MACH.

Wanted—First-class tool-room foreman on jigs and fixtures; one who can get rapid and accurate production from a first-class equipped tool room. Box 935, AMERICAN MACHINIST.

MISSOURI

Wanted—Mechanical draftsman who has had experience designing woodworking machinery; state age, experience and give references. Apply Box 14, AMER. MACHINIST.

Wanted—An experienced man as foreman of machine shop employing about 100 men, who thoroughly understands the manufacture of woodworking machinery; must have occupied similar position; applicant will state age experience and give references. Box 13, AMERICAN MACHINIST.

NEW YORK

Wanted—A thoroughly competent web printing press draftsman; man of experience and ability can have permanent position at high salary; communications confidential. "W. W. C.," AMERICAN MACHINIST.

Wanted—For New York territory, an experienced printing-press salesman to represent an old established concern; only competent men need apply, stating salary and full particulars; confidential. Address Box 18, AM. M.

Wanted—First-class hand screw machine foreman; job also includes two Brown & Sharpe and one large sized Gridley automatic; man must be resourceful and first-class handler of help; good pay to the right party. Box 16, AMERICAN MACHINIST.

Wanted—A competent translator, from and into German, of catalogs of machinery; work to be done at home and furnished neatly typewritten; state nationality, where educated, business experience and references. Address "Nanusa," AMERICAN MACHINIST.

Superintendent to take charge of shop production; must have extensive practical experience; good organizer; applicants please give full particulars. Niagara Machine and Tool Works, manufacturers of punch presses and sheet metal machinery, Buffalo, N. Y.

Shop superintendent wanted to take charge of machine shop, structural shop and foundry near New York, making power transmission machinery, conveyers, etc.; experience in the manufacture of cast-iron pulleys and hangers is essential; a good salary will be paid to a bright, hustling, practical man who can handle about three hundred men, take charge of manufacturing, and at the same time reorganize and repair a plant equipment that has been somewhat neglected. Address reply, stating experience to "Superintendent, P. O. Box 824, New York."

OHIO

Wanted—First-class machinists; no labor troubles. The Heisler Co., St. Marys, O.

Wanted—Mechanical and electrical foreman, experienced in electric and steam power, heat, light and general millwright work; capable of having complete charge of power plant and all machinery with a large manufacturing company. Box 19, AMERICAN MACHINIST.

Machinists—We are increasing our output and invite application from machinists with experience on planers, turret lathes, boring mills, milling machines, screw machines, etc.; state fully, experience and wages. Foos Gas Engine Co., Springfield, Ohio.

Wanted—First-class machinists, toolmakers, die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood patternmakers, brass molders, polishers, buffers, finishers, spinners, millwrights, hammermen and blacksmiths who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Bldg., Cleveland, O.

PENNSYLVANIA

Power press foreman; first-class man on large and small metal specialties; good position for the right man; state fully experience and salary expected. Box 7, AMER. MACH.

Wanted—Foreman for small shop manufacturing medium weight specialties; must be familiar with modern methods and systematic; state age, experience and whether married; a good salary will be paid to the right man. Box 988, AMERICAN MACHINIST.

Wanted—Superintendent for foundry and machine works employing from 150 to 200 hands engaged in manufacture of single and four valves automatic engines and general foundry work; must be thoroughly abreast of the times, practically and theoretically capable of taking entire charge of manufacturing departments and of acting in capacity of advisory engineer; position open January 15, 1910. Address, stating experience and with references, "Inertia," care AMER. MACHINIST.

RHODE ISLAND

Wanted—Twenty-five first class tool designers; steady employment for men who can do the work in a satisfactory manner. Address The Taft-Peirce Manufacturing Company, Woonsocket, R. I.

Wanted—Twenty-five first class tool and die makers on blanking, perforating and bending dies; steady employment for men who can do the work in a satisfactory manner. Address The Taft-Peirce Manufacturing Co., Woonsocket, R. I.

Wanted — Twenty-five experienced draftsmen to design all classes of special tools for the economical manufacture of interchangeable machine parts; steady employment to capable men. Address The Taft-Peirce Manufacturing Co., Woonsocket, R. I.

Miscellaneous Wants

Caliper catalog free. E.G. Smith, Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Machines designed; automatic special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emery & Co., Newark, N. J.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Arthur C. Mason, designing engineer; practical working drawings; special machinery developed. 227 Canal St., New York City.

Drawings for automatic and special machines made; designing pumps, attention given. Address "Mechanical," Box 1, AM. MA.

Would like to contract with machinery builders to furnish castings of medium weight. Lewistown Foundry and Machine Company, Lewistown, Pa.

Wanted—Samples of tools for flour mill roll corrugating machines 1"x1¼"—16, 18 and 20 corrugations per inch. Box 987, AMERICAN MACHINIST.

Special machinery developed; practical working drawings prepared by experienced designers. The Engineering Service Co., 413 Fort Dearborn Building, Chicago, Ill.

Machinery to manufacture on contract; designers, patternmakers and founders; we can handle work from very light up to 15 tons. Hydrostatic Machinery Co., Rochester, N. Y.

Wanted—Purchaser for No. 2 Farwell milling machine, Grant hobbing machine and Gisholt tool grinder; all practically new and in A-1 condition. Box 755, AMER. MACHINIST.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

An old established English firm is prepared to take out and purchase really good sound inventions for Europe, or will make and sell on royalty; bankers reference given. Fastnut, Ltd., 60, Aldermanbury, London, Eng.

Wanted—Machine work; to know the names of concerns who are fitted for and are able to handle all kinds of machine work, as we have a large amount of machine work at all times which we wish to have done outside of our own factory, such as gear cutting, etc. Matheson Motor Car Co., Wilkes-Barre, Pa.

Wanted—To purchase a machine and foundry business, employing not less than fifty men; must have an established trade, show good profits and good reason for selling; purchasers wish business to combine with other lines now being manufactured. When writing give full particulars. Box 940, AMERICAN MACHINIST.

Manufactures facilities, 300 miles from New York City, modern machine shop equipment; 2-foot to 7-foot planers; 12 to 50-inch lathes; milling machines; radial and sensitive drills; shapers, slotters, grinders, etc., new and modern; ten ton traveling crane; also pattern department, foundry and smith shop; railway siding in works; suitable for making steam or gas engines, pumps, compressors, motor trucks, or other medium weight machinery; will manufacture on contract or might take up the manufacture and sale of good article if desired. Box 9, AMER. MACH.

For Sale

For Sale—Small machine shop, well equipped on belt railway; lot 250x150; $2500. Reasonable terms. Patterson & Norred, Real Estate & Insurance, Chattanooga, Tenn.

For Sale—The machine and tool equipment formerly owned by the Dayton Hydraulic Machinery Company, of Dayton, Ohio. This equipment has been placed in our hands to dispose of and offers an exceptional opportunity to a quick purchaser. For full particulars address the Patterson Tool and Supply Co., Dayton, Ohio.

Trade Catalogs

D. H. Burrell & Co., Little Falls, N. Y. Pamphlet illustrating and describing B-L-K vacuum pump.

Greenfield Machine Company, Greenfield, Mass. Circular illustrating and describing universal grinder.

Consolidated Safety Valve Company, 85 Liberty street, New York. Catalog describing pop safety valves. Illustrated, 78 pages, 6x9 inches, cloth.

The Bristol Company, Waterbury, Conn. Bulletin No. 114, describing recording gages for pressure and vacuum. Illustrated, 48 pages, 8x10½ inches.

Harvey Hubbell, Bridgeport, Conn. Supplement No. 12, describing shades, shade holders and lamp guards. Illustrated, 40 pages, 3½x6½ inches.

The Cincinnati Bickford Tool Company, Cincinnati, Ohio. Loose leaf catalog of upright drilling and tapping machines. Illustrated, 9x12 inches, paper.

Joseph T. Ryerson & Son, Chicago, Ill. Ryerson Reference Book, containing list of stock of iron, steel machinery, etc. Illustrated, 380 pages, 4x7 inches, paper.

The L. L. Lord Company, Meadville, Penn. Catalog No. 6, showing tools for plumbers, machinists, electricians, blacksmiths, etc. Forty-eight pages, 4½x8 inches, paper.

Hydro Manufacturing Company, 720 Lewis Block, Pittsburg, Penn. Catalog describing Hydro recording gas volume and velocity gages. Illustrated, 8 pages, 6x9 inches.

Wiener Machinery Company, 50 Church street, New York. Folder illustrating and describing S & N tools for cutting structural material and other machinery for structural shops.

Hauck Manufacturing Company, 140 Cedar street, New York. Pamphlet No. 30, describing fuel oil burners and forges for machine shops, forge shops, etc. Illustrated, 8 pages, 6x9 inches.

North Brothers Manufacturing Company, Philadelphia, Penn. "Yankee" tool book, describing ratchet screw drivers, spiral screw drivers, automatic or hand drills, etc. Illustrated, 32 pages, 6x6 inches.

Palmer Bros., Cos Cob, Conn. Catalog describing stationary gasolene engines, gasolene hoisting engines, wood-sawing machine, marine engines and launches. Illustrated, 32 pages, 5x7 inches, paper.

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